# MECHANICAL ENGINEERING

August 1960

ANNUAL REVIEW

A Review of Heat Transfer Literature 1959, 47

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CHANGE OF PHASE • RADIATION • LIQUID METALS
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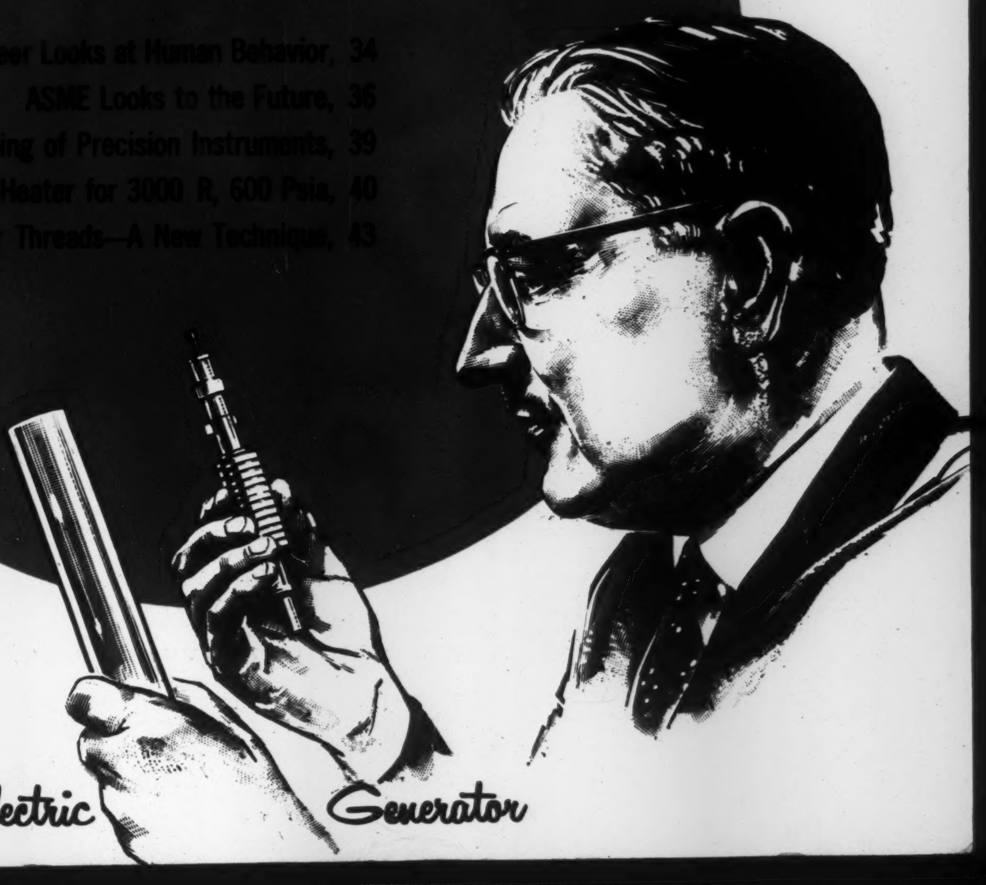
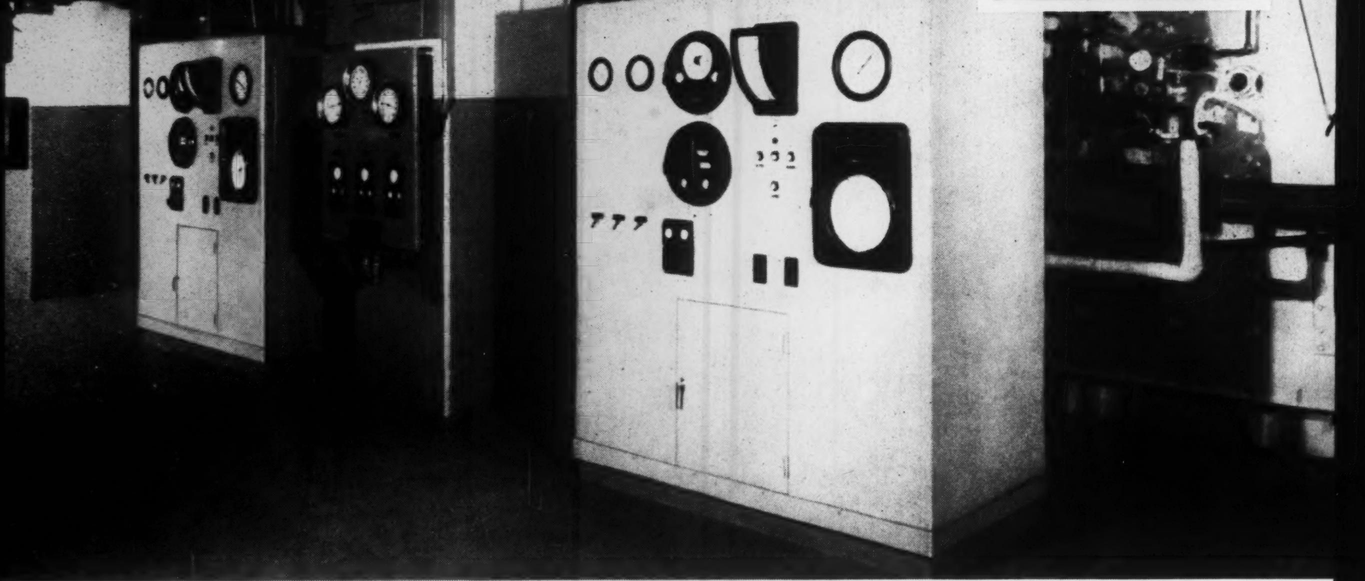


Thermionic-Thermoelectric Generator

# New B&W Boilers Cut Heating Costs 22% for Country's 3rd Largest Building



### American Furniture Mart Corporation replaces 3 previous boilers with 2 B&W package units . . . Heats 29 Million cubic feet at fuel cost saving of 22%

The American Furniture Mart dominating Chicago's skyline with a 17 story building topped by a 33 story tower . . . has 29 million cubic feet of space to be heated. It is the largest commercial building in the world devoted to a single industry, home furnishings. Throughout the year, it is the national purchasing center for thousands of retail stores, large and small, and at peak markets, upwards of 45,000 buyers and sellers shop its display spaces. The recent installation of two B&W boilers . . . in place of three previous units . . . provides all the steam necessary for this large heating job at a fuel cost saving of 22%. Additional economies can be realized because fuels can be switched in a matter of minutes to use the fuel most economical at any given time. Moreover, these new boilers are fast steaming . . . put out plenty of heat in a hurry even after being turned off all night.

In addition to cutting fuel costs, a savings that will pay for the units in five years, these B&W package boilers cut space requirements in half and require fewer men to keep them in operation. It is interesting to note, too, that these boilers were installed during the height of the heating season . . . with minimum loss of heat to the building's occupants during the changeover period. Furthermore, management knows that any time in the life of the boiler—10, 20 or 30 years hence—B&W's nation-wide service organization will be promptly and economically available if needed.

Providing the efficiency, economy, and service necessary to heat the country's third largest building economically is further evidence-in-action of dependable steam generation by B&W. Whatever your steam requirement . . . whatever your most economical fuel . . . B&W has the boiler best suited to your heating application. For information, contact your local B&W representative. He has all the facts on your area. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

**B&W—THE NATION'S LEADING MANUFACTURER OF INDUSTRIAL BOILERS**

G-972-1B

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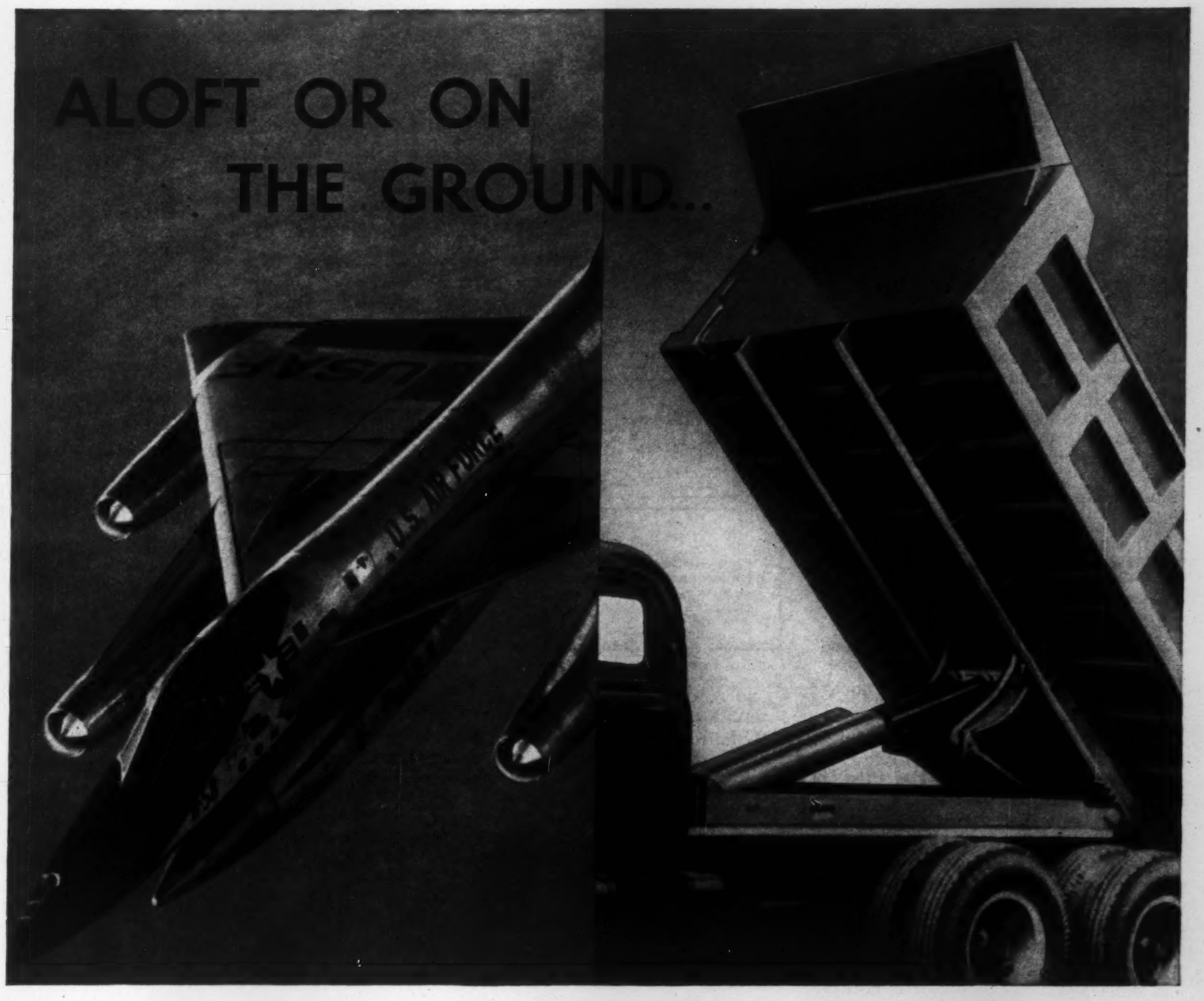
***BOILER DIVISION***

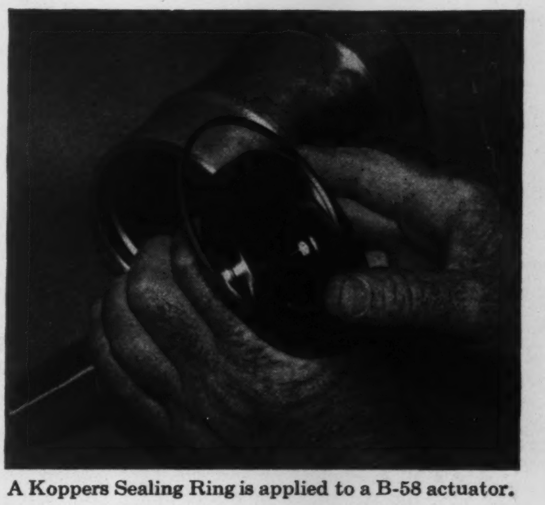


# Koppers Sealing Rings give ensured actuation!

**Koppers solves diverse and difficult sealing problems.**

Modern supersonic jets and dump trucks—as dissimilar as they appear—both depend on Koppers Sealing Rings for efficient hydraulic system operation. Koppers *Predictable Performance* Sealing Rings are used in a wide variety of applications . . . engineered to satisfy each requirement of both hydraulic and pneumatic sealing.

Koppers has the technological skill, gained through 38 years of experience, to meet the most critical performance requirements in any sealing application. Look to Koppers to solve your sealing problems. For an informative booklet on Metallic Sealing Rings write to: KOPPERS COMPANY, INC., 6808 Hamburg Street, Baltimore 3, Maryland.



A Koppers Sealing Ring is applied to a B-58 actuator.

KOPPERS

**SEALING RINGS**

**Engineered Products Sold with Service**

# Some Straight Talk On Steam Trap Capacity

## . . . or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counterclaims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

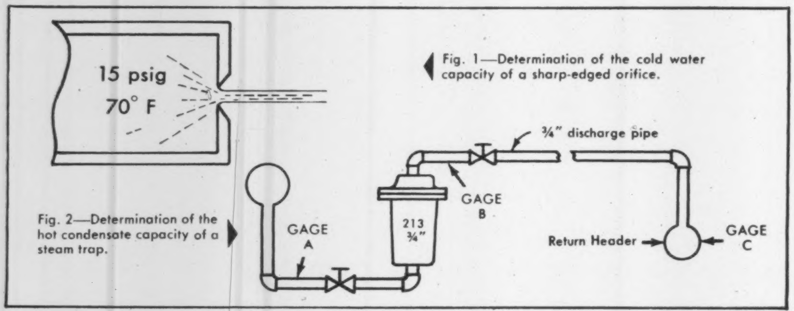


Fig. 1—Determination of the cold water capacity of a sharp-edged orifice.

Fig. 2—Determination of the hot condensate capacity of a steam trap.

### What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

*Area of orifice* is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

*Density of condensate* depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

*Pressure differential across the trap* is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.
2. Distance the trap valve is moved from the valve seat.
3. Back pressure on the trap with orifice closed; i.e., return header pressure.
4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

### Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:

*Density of condensate.* As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

*Pressure differential across the trap.* With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

### How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hook-ups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

* * *

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

**Armstrong Machine Works**
**8944 Maple Street**
**Three Rivers, Michigan**

**ARMSTRONG STEAM TRAPS**

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**THE COVER**

Heat of fission converted directly into power. Dr. W. E. Shoupp, Mem. ASME and technical director of the Westinghouse atomic power department, holds a combination thermionic-thermoelectric device designed to extract electric power from the fuel elements in a nuclear reactor. The generator was built into a nuclear fuel rod and inserted into the Westinghouse Testing Reactor at Waltz Mill, Pa., to produce the first power to come from such a device. See Briefing the Record, page 68.

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Quick! What effect do the following have on a creative engineering group: Praise, pressure, loyalty, confusion? For many reasons we'd better move toward a deeper understanding of human motivations.

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It's your Society. You'll be interested in the President's mid-year report. Where do we stand on membership, on unity with the other leading engineering societies, on international relationships?

**PACKAGING AND HANDLING OF PRECISION INSTRUMENTS............**
**..............................................Arthur Bleimeyer, Jr.** 39

Don't breathe until those delicate instruments are safely installed. As purchaser, you need to be aware of the special care required in their handling. Suggestion: Use an Impact-O-Graph recorder.

**AIR HEATER FOR 3000 R, 600 PSIA..........................M. H. Bloom** 40

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Most methods for checking taper threads measure one thread element in one plane. Here is a device that gives the true over-all thread configuration, registered electrically and recorded on charts.

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**...E. R. G. Eckert, J. P. Hartnett, T. F. Irvine, Jr., and E. M. Sparrow** 47

It was the year our Journal of Heat Transfer made its debut. In today's high-speed, high-temperature engineering, heat transfer takes a position of first importance. Here is the Annual Report.

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B&W
WELDING
FITTINGS
6" SCH 40 B&W WPB CB
MADE BY MEN
WHO KNOW
STEEL

B&W Welding Fittings manufacturing is integrated with the Division's own steel-making and tube-making facilities. Consider the relation between steel-making and the manufacture of welding fittings . . . B&W not only knows the complexities of fittings manufacturing, but also has an intimate knowledge of the making of the steels from which the fittings are formed. Integration plus knowledge naturally makes for a superior product. It enables B&W to provide a completely quality-controlled fitting, matched to end-use service. It also can mean better deliveries of welding fittings made from the specialized steels because B&W can control scheduling from melt to shipment of the finished material.

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ABC

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# FOOTE BROS. introduces a
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- High load carrying capacity
- Super-efficient 2-way cooling for higher thermal ratings
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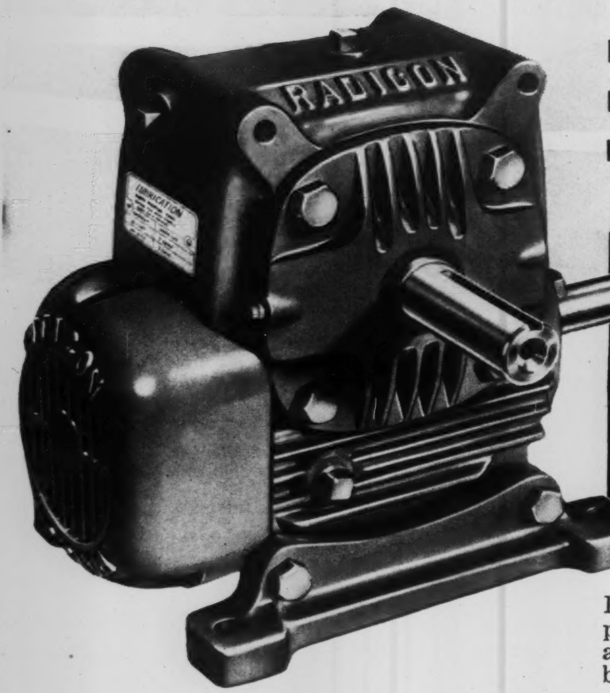

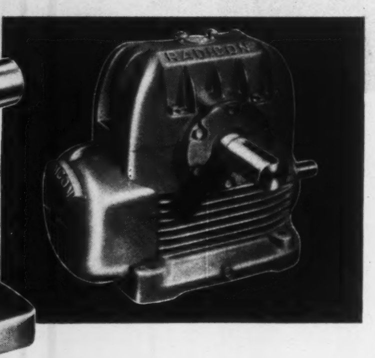

- 12 sizes—Center Distances from 1⅛″ to 8″
- Rated to NEW AGMA Standards
- Ratios from 5:1 to 70:1
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- Input capacities from .01 to 66 HP

Foote Bros. RADICON Worm Gear Reducers incorporate *totally new* concepts of speed reducer design and construction. From the inside out and top to bottom, they embody years ahead thinking to provide users with more efficient, more versatile right angle power transmission in minimum size units.

Gear accuracy and surface finish, bearing and shaft design, positive lubrication, extreme efficiency controlled cooling, the selection of materials and precision manufacturing techniques—all reflect careful attention to detail that results in higher load carrying capacity and maximum service life.

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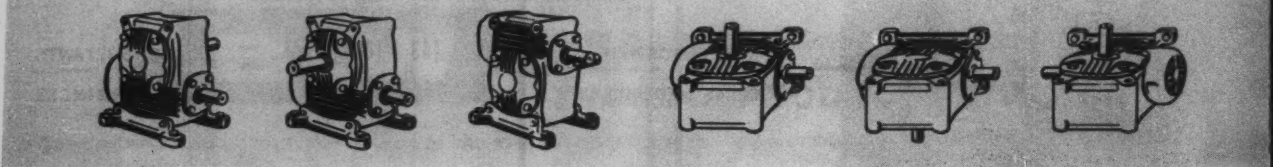
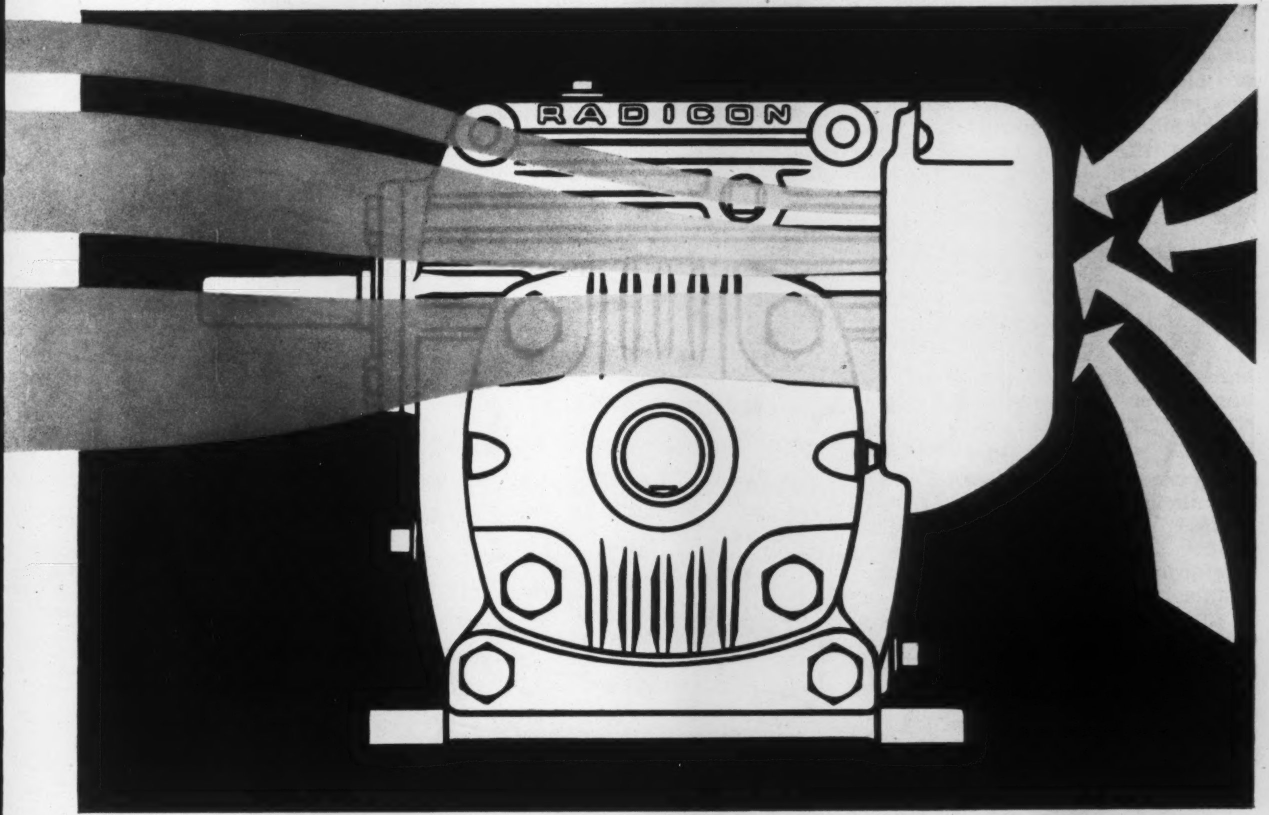
***UNLIMITED MOUNTING POSITIONS***



# COMPLETELY NEW and ADVANCED line of WORM GEAR REDUCERS



## RADICON Reducers operate in a STREAM OF AIR for maximum thermal efficiency

Advanced design of RADICON Worm Gear Reducers and their high efficiency radiation and convection cooling for controlled transfer of heat to the outside air, permit *identical* thermal and mechanical ratings in most cases. For infrequent or intermittent service, thermal ratings can be ignored.

A moving stream of air, induced by the maximum diameter fan, forcing high velocity cooling air along horizontal channels formed by the external ribbing, dissipates radiated heat to hold the Reducer's temperature rise to a minimum. Cooling is equally efficient at any mounting position.

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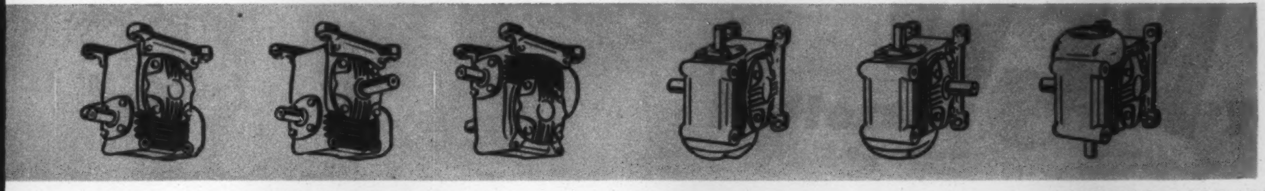
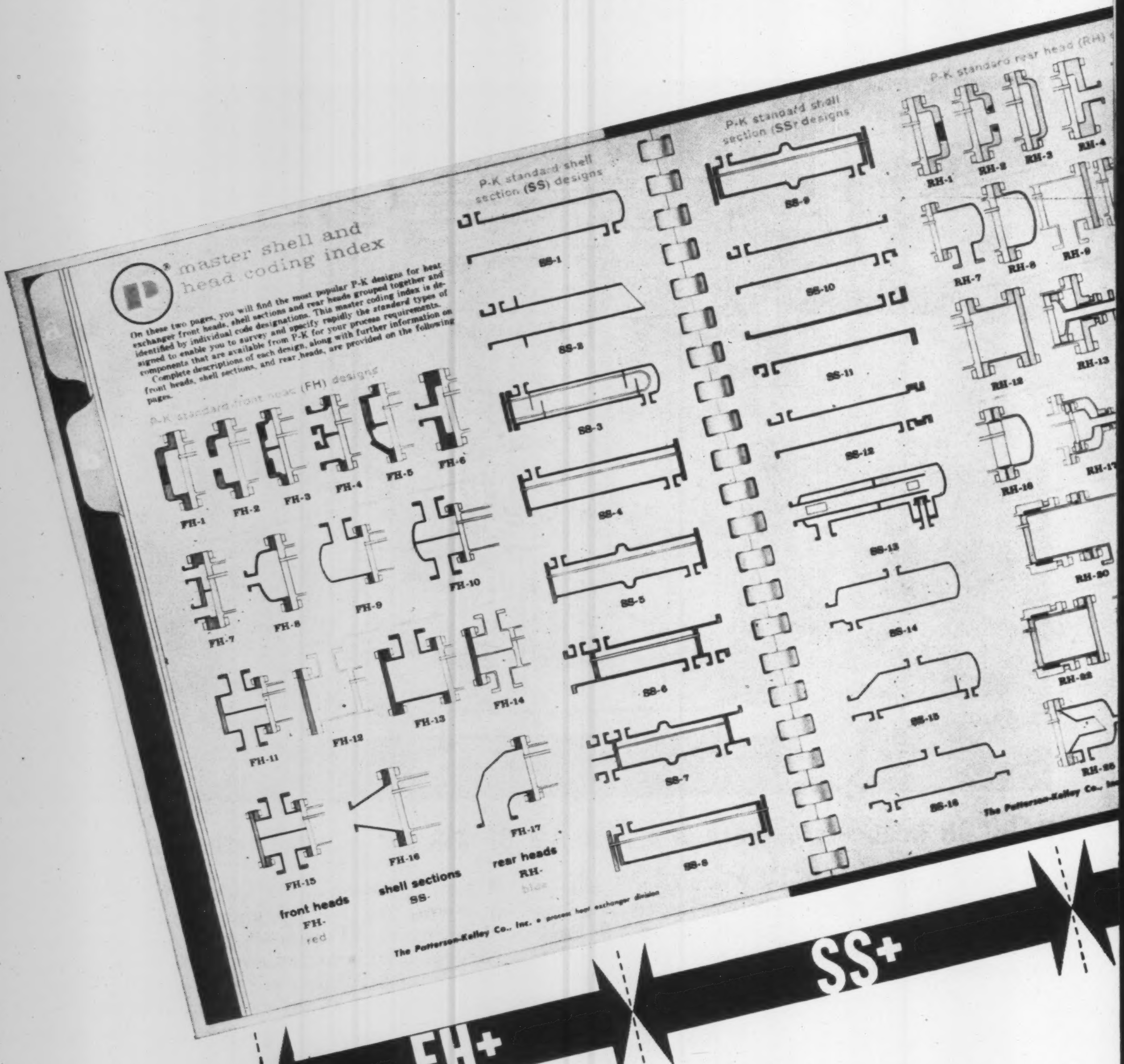




master shell and head coding index

On these two pages, you will find the most popular P-K designs for heat exchanger front heads, shell sections and rear heads grouped together and identified by individual code designations. This master coding index is designed to enable you to survey and specify rapidly the standard types of components that are available from P-K for your process requirements.

Complete descriptions of each design, along with further information on front heads, shell sections, and rear heads, are provided on the following pages.

P-K standard front head (FH) designs

P-K standard shell section (SS) designs

P-K standard rear head (RH)

front heads FH- red

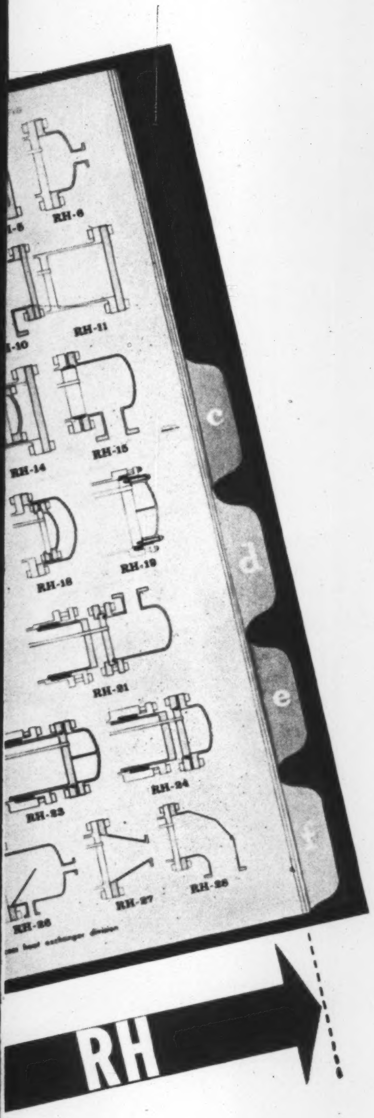
shell sections SS-

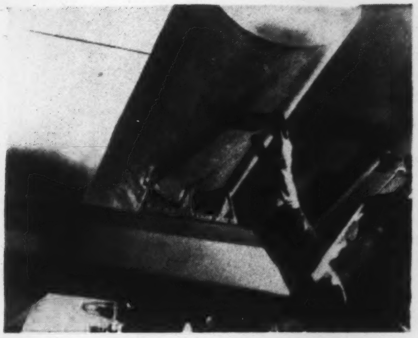
rear heads RH- blue

The Patterson-Kelley Co., Inc. a process heat exchanger division

FH-1
FH-2
FH-3
FH-4
FH-5
FH-6
FH-7
FH-8
FH-9
FH-10
FH-11
FH-12
FH-13
FH-14
FH-15
FH-16
FH-17
SS-1
SS-2
SS-3
SS-4
SS-5
SS-6
SS-7
SS-8
SS-9
SS-10
SS-11
SS-12
SS-13
SS-14
SS-15
SS-16
RH-1
RH-2
RH-3
RH-4
RH-7
RH-8
RH-9
RH-12
RH-13
RH-16
RH-17
RH-20
RH-22
RH-25
The Patterson-Kelley Co., Inc.
FH+
SS+

# NEW SIMPLE FORMULA IN P-K HEAT EXCHANGER





**AEC using P-K Heat Exchanger.** This P-K Heat Exchanger runs 24 hours a day, 5 to 7 days a week, at the Uranium Processing Plant at Weldon Spring, Mo., operated for the AEC by Mallinckrodt Chemical Works. Although placed in operation in April 1958, and handling highly corrosive hydrofluoric acid at temperatures above 300°F., this two-pass shell and tube type unit has never once required maintenance.

Select the *Front Head* you want, from the *FH* group. Add the *Shell Section* you want, from the *SS* group. Add the *Rear Head* you want, from the *RH* group.

Follow these three simple steps and the formula above enables you to select the "designed" heat exchanger that meets your requirements.

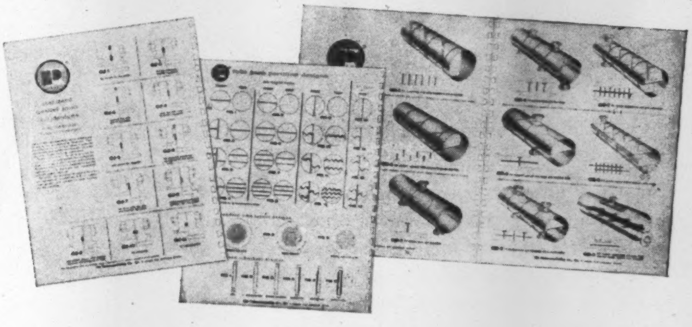
As you can see, the two pages at left from the new P-K Heat Exchanger Manual provide a master coding index. This makes it possible to rapidly survey and specify the standard interchangeable components available from P-K. Succeeding pages treat design features of each component in detail and save you time when you want to determine their suitability for your application.

Suppose, for example you want an exchanger with the following: front head bonnet, multi-pass, radial flanged connections; shell section with straight tube floating head, and pull through removable bundle construction; straight tube floating rear head, pull through removable bundle and shell cover plate, with multiple pass. Consult your P-K Manual, pages b-1 through b-18. Then specify FH-10+SS-10+RH-14.

Clear, parallel picturization of standard gasket joints, tube pass partitions, shell baffles and other components simplifies the underlying details of designs.

Other sections of the manual standardize terminology, review fundamentals of heat transfer and design, even discuss economic considerations.

Since available copies of the new P-K Heat Exchanger Manual are limited in number, they are reserved primarily for those in the process industries who can most profitably use the information. If you design or specify heat exchangers, write us on your company letterhead, outlining briefly the areas of your interest. A few copies are available to students and non-technical personnel at a nominal charge. The Patterson-Kelley Co., Inc., 120 Burson Street, East Stroudsburg, Pa.



# MANUAL HELPS YOU SELECT YOUR HEAT EXCHANGER

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Heat Exchanger Division

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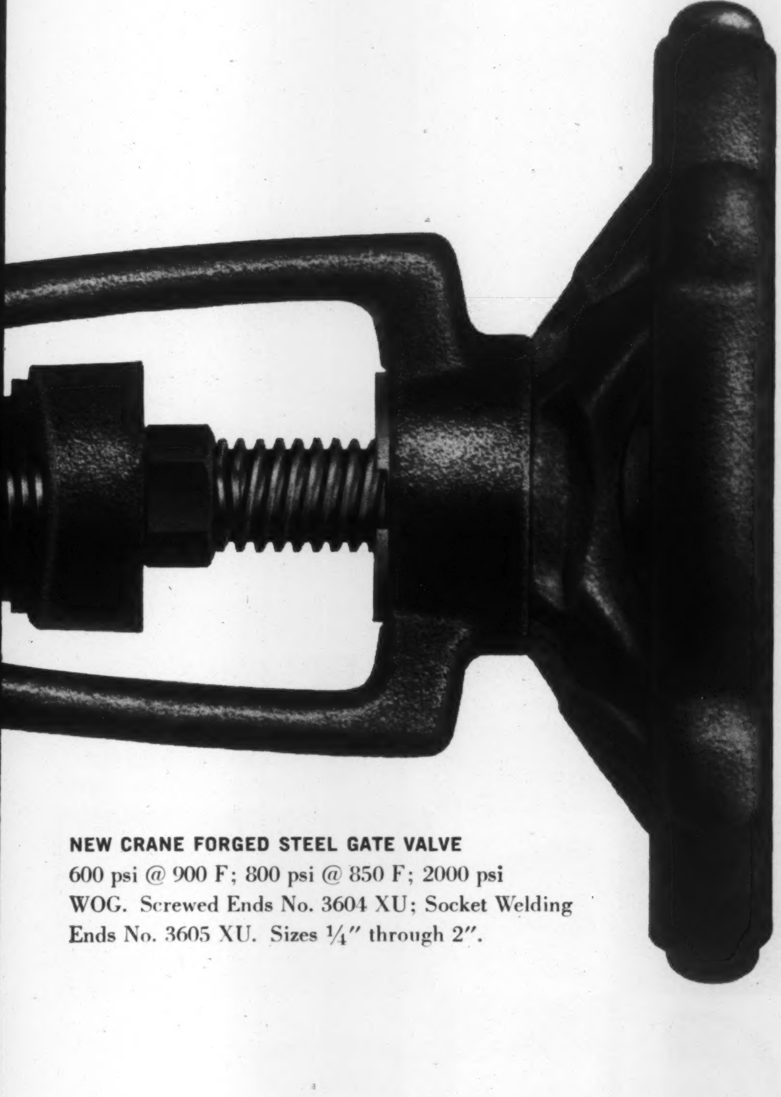

**NEW CRANE FORGED STEEL GATE VALVE**
600 psi @ 900 F; 800 psi @ 850 F; 2000 psi WOG. Screwed Ends No. 3604 XU; Socket Welding Ends No. 3605 XU. Sizes 1/4″ through 2″.

This is a whole new valve, not just one with a new feature added. This redesign incorporates all the features you told us you wanted plus a few others we know will make this valve a better buy in terms of longer service life, less maintenance, easier and faster servicing.

Like the new "bow-leg" yoke, which for the first time gives you plenty of hand room for easy stuffing box maintenance. And like the long-life braided asbestos packing, with Inconel wire insert. The "universal" trim that can be used for either oil or steam, eliminating many of your stocking problems. The spiral wound stainless steel bonnet gasket with asbestos filler, made blowout-proof with a male-female joint.

But what we really want you to remember, more than any single feature, is that this Crane valve is the newest—all new—valve on the market . . . well worth considering when you need small, high-pressure steel gate valves. We'd like you to compare this new valve with any other comparable valve feature for feature.

Your local Crane distributor has technical literature and a complete selection of these valves right in stock. Call him on small steel gates. In fact, he's your best bet to call no matter what valve you want because he carries the broadest line of quality valves in the world.

CRANE ®

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180° RETURNS
"PLUG-N-CAPS"
TEES
STUB ENDS
CONCENTRIC REDUCERS
ROTATING INSERT FLANGES
90° ELBOWS
ECCENTRIC REDUCERS
45° ELBOWS
PIPE-MATE

# TURNS...

# PIPE-MATE light-wall stainless steel fittings and flanges

Tube Turns introduces another important key to lower piping costs . . . a new line of light-wall stainless steel fittings and flanges for process piping. Here's how this PIPE-MATE* line reduces costs . . .

**Cuts material costs.** Compared to standard weight Schedule 40S pipe, *light-wall* piping in Schedule 5S or 10S cuts material costs as much as 30% to 50%. It weighs ½ to ⅓ as much, is easier to handle, easier to install and provides greater flow area.

**Simplifies installation.** Extra long tangents of PIPE-MATE fittings provide full straight-line clearance for fitting-to-fitting connections and permit fabrication of completely flanged elbows, returns, tees, etc. Aligning connector speeds making of socket type joints. Fittings may be butt-welded, fillet-welded, brazed or soldered, or joined by rolled-in flange connections.

Here is another plus value you get when you specify products of Tube Turns and buy them from your Tube Turns' Distributor.

**FREE BULLETIN on PIPE-MATE** Fittings and Flanges describes complete line, shows installation procedures, and gives properties and dimensional tolerances. Mail coupon for copy.

*"PIPE-MATE" and "tt" are trademarks of Tube Turns.

*Another tt plus value from...*

**TUBE TURNS**

**DIVISION OF CHEMETRON CORPORATION**

**Louisville 1, Kentucky**

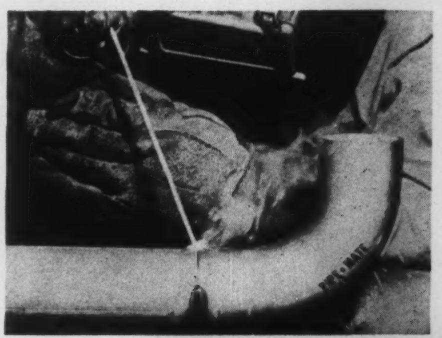
CHEMETRON

DISTRICT OFFICES: Atlanta • Buffalo • Chicago • Columbus • Dallas • Denver Detroit • Houston • Kansas City • Los Angeles • Midland • New York Philadelphia • Pittsburgh • Richmond • San Francisco Seattle • Tulsa

*In Canada:* TUBE TURNS OF CANADA LIMITED, Ridgetown, Ontario

*District Offices:* Edmonton • Montreal • Toronto

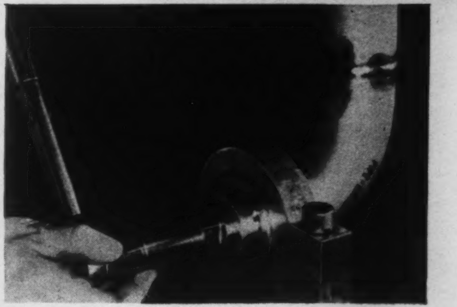
*In Mexico:* TUBE TURNS DE MEXICO, Mexico City



FOR BUTT-WELDING

FOR FILLET-WELDING, BRAZING OR SOLDERING

FOR ROLLED-IN FLANGED JOINTS



**TUBE TURNS**
**Department ME-8, 224 East Broadway**
**Louisville 1, Kentucky**
Please send bulletin TT944AR.

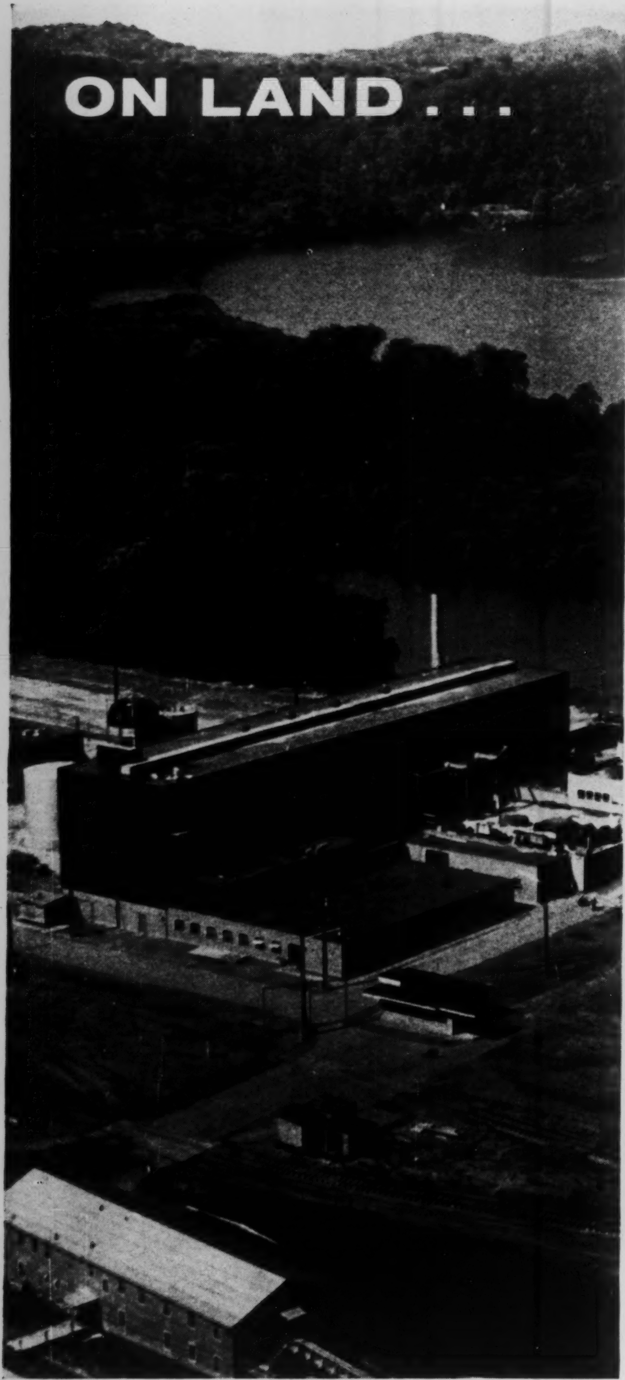
*Company Name* ____________________

*Company Address* ____________________

*City* ____________________ *Zone* ______ *State* ______

*Your Name* ____________________

*Position* ____________________

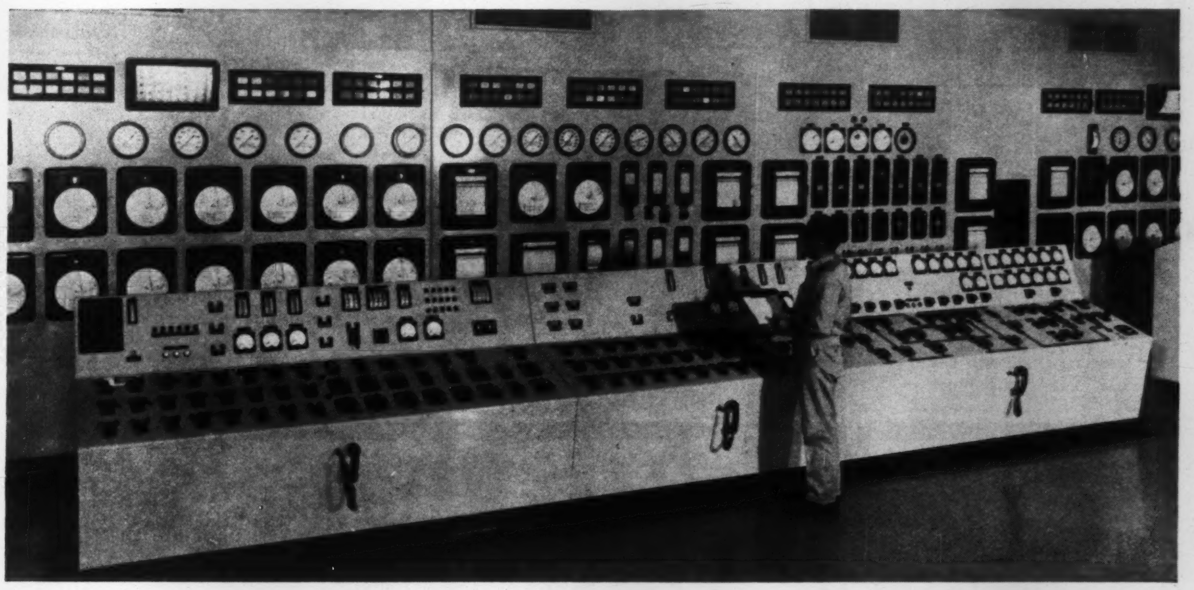


At the Shippingport Station, world's first full-scale atomic, electric power plant devoted exclusively to civilian use, Bailey instruments and controls help to secure full capacity and safety.

Typical of the modern U.S.-Flag tanker fleet using Bailey controls is the ESSO Gettysburg. You'll also find Bailey controls aboard Naval ships, cargo ships and lake steamers.

Bailey meters and controls in centralized control room at Tulsa Power Station, Public Service Company of Oklahoma. In steam-electric generating plants of this kind, Bailey has installed more combustion, feed water and steam temperature controls than have all other makers combined.

# IT'S BAILEY...



## for the latest and safest instruments and controls for nuclear and conventional power plants!

Many of the power plants of the future will have controls and instruments designed and built by Bailey. There are two reasons: Bailey's continuing research and development toward the latest equipment for industry's needs; Bailey's 40-year association with the hardware and economic requirements of the industry.

If you are planning new or improved power plant facilities, call on Bailey engineers to insure that your system will have the *proper balance both as to economics and needs . . . that there will not be the unnecessary expense of over-instrumentation or control . . . nor the duplication of equipment functions.*

Call on Bailey for primary sensing devices, indicators, loggers, control units, panels, data handling equipment, computers for performance analysis, and supervisory controls. You'll find designs ranging from conventional to the most sophisticated . . . mechanical, pneumatic, electric and electronic, including solid state.

There's a Bailey District Office or Resident Engineer close to you. Check your phone book, or write direct.

A142-2

BAILEY METERS

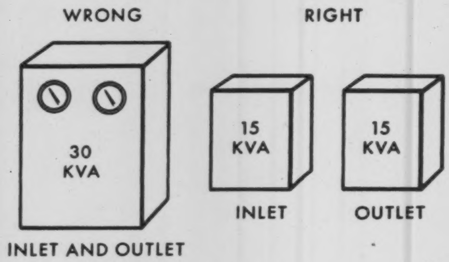
***Instruments and controls for power and process***

**BAILEY METER COMPANY**

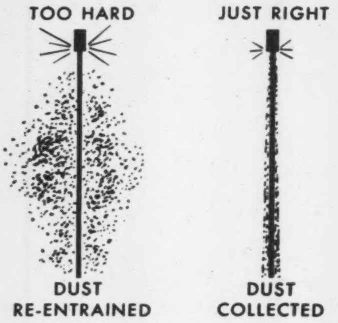
***1026 IVANHOE ROAD • CLEVELAND 10, OHIO***

**In Canada—Bailey Meter Company Limited, Montreal**

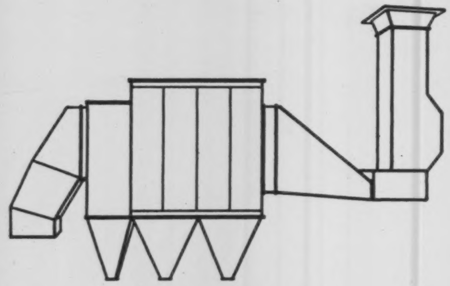
# How to Evaluate Cottrell Precipitators



**1. Electrical Sets** should be arranged and rated to suit best the requirements of a specific job. Since electrical conditions can vary widely at different parts of the precipitator, it is good design to include several electrical sections in series, energized from separate sets so that each section may be energized as needed. Sets should be sized according to the amount of power the precipitator can absorb. A large excess of installed power, which will never be absorbed, means inefficient use of its equipment.

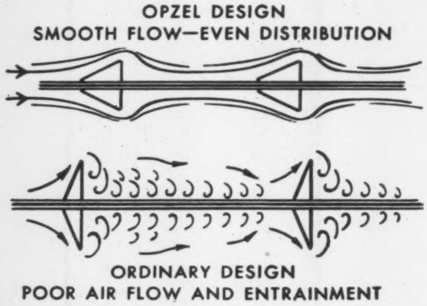


**3. Rapping Intensity.** Rappers should have easy means to vary the intensity of the blow to suit variations in operating conditions. A pre-set intensity setting cannot possibly give proper rapping over the normal range of operation. If too soft, build-up will occur which will disturb electrical conditions. If too hard, there will be reentrainment. Means of intensity adjustment are necessary to avoid drop-off of precipitator efficiency as conditions change.



3 DIMENSION MODEL

**2. Gas Distribution.** Remember that gas distribution, gas baffling, and provision against hopper sweeping all have a large influence on collection efficiency. The gas flow system should be analyzed as closely as possible, both in the precipitator and in the associated duct-work. If in doubt, have a three-dimensional gas flow study made. Two-dimensional gas flow studies *are not as accurate* and may lead to erroneous conclusions.



**4. Baffle Design.** Careful attention to the design of baffles on the collecting plates is most important. Small amounts of reentrainment mean tremendous differences in over-all collection efficiencies. It is seen that the "quality" of the collecting surface is far more important than quantity—quantity (sq. ft. of surface or treatment time) in itself is not a criterion of performance.

**The point of all this** is that so many factors enter into evaluating an electrical precipitator that you should consult with the leading manufacturer—Research-Cottrell

**Research-Cottrell, with over 1198 years of combined engineering skill and experience, is the undisputed leader in electrical precipitation.**

**Research-Cottrell**

RESEARCH-COTTRELL, INC., Main Office and Plant: Bound Brook, N. J.
Representatives in principal cities of U.S. and Canada

TRADE MARK

RC 204

# Cleveland Speed Variator accurately controls paper web fed into Schriber Printing Press

This new Rotary Offset Business Forms Press built by Schriber Press Company of Dayton, Ohio, was designed to provide printers with more hourly impressions—more daily output.

Its new infeed web tension control drive gives absolute constant tension from mill roll through a Cleveland Speed Variator-driven metering cylinder to press.

The Variator compensates for paper thickness—maintains constant surface speed of paper to the press—guarantees finished printing will always stay "in register".

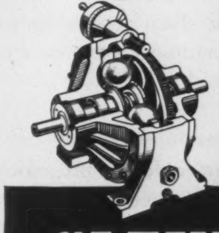
A modified Cleveland Speed Variator providing increased precision within a limited ( ± 25% ) range was selected for this important function. This was accomplished by changing the curve of Variator's iris plate. Thus, this Variator allows exacting adjustment for paper machine tension—holds that tension or can easily be changed to another speed setting.

If your operations demand speed variation, be sure to get the complete "Cleveland Speed Variator Story". It's all in free Bulletin K-200 —write for your personal copy today.

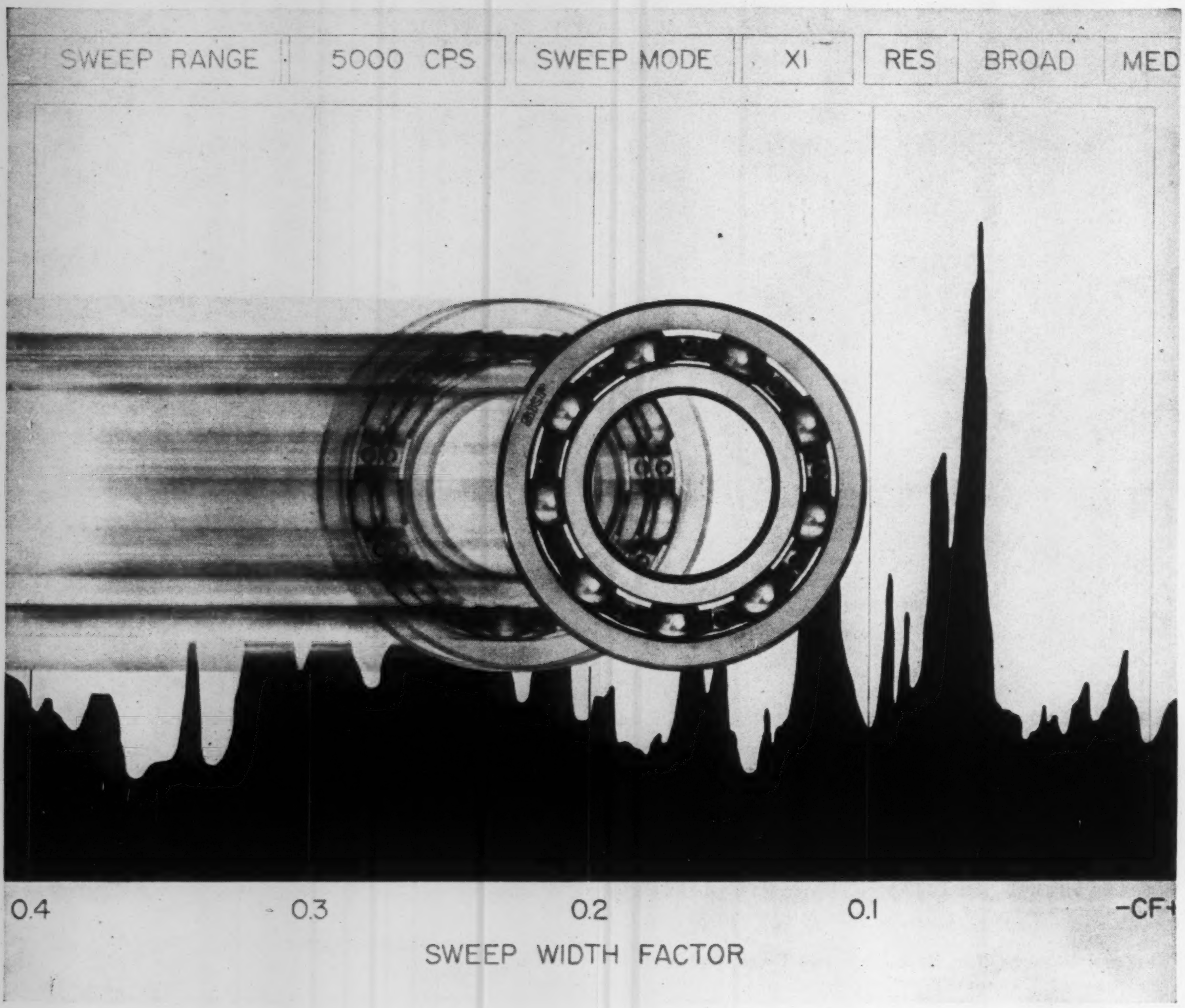
**Cleveland Worm & Gear Division**
Eaton Manufacturing Company
3264 East 80th Street • Cleveland 4, Ohio

**HOW IT WORKS**

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, left).



**CLEVELAND SPEED VARIATOR**



# Now, SKF reduces the noise level of ball bearings by 50%!

**New SKF ball bearings run twice as quietly as standard single-row deep-groove bearings** — six times more quietly than bearings produced just two years ago.

**They're designed especially for applications where noise is an important factor.** Eight manufacturers, who use-tested them for over a year, now back-up their approvals with repeat orders.

**Every bearing meets new, more critical standards.** Each type and size meets special requirements for reduced vibration. Every ball meets very low waviness limits. Each cage meets critical standards for smooth, quiet performance.

**SKF will make a comparison check of these improved bearings against the bearings you're now using.** See for yourself! Just call the SKF branch office nearest you.

6013

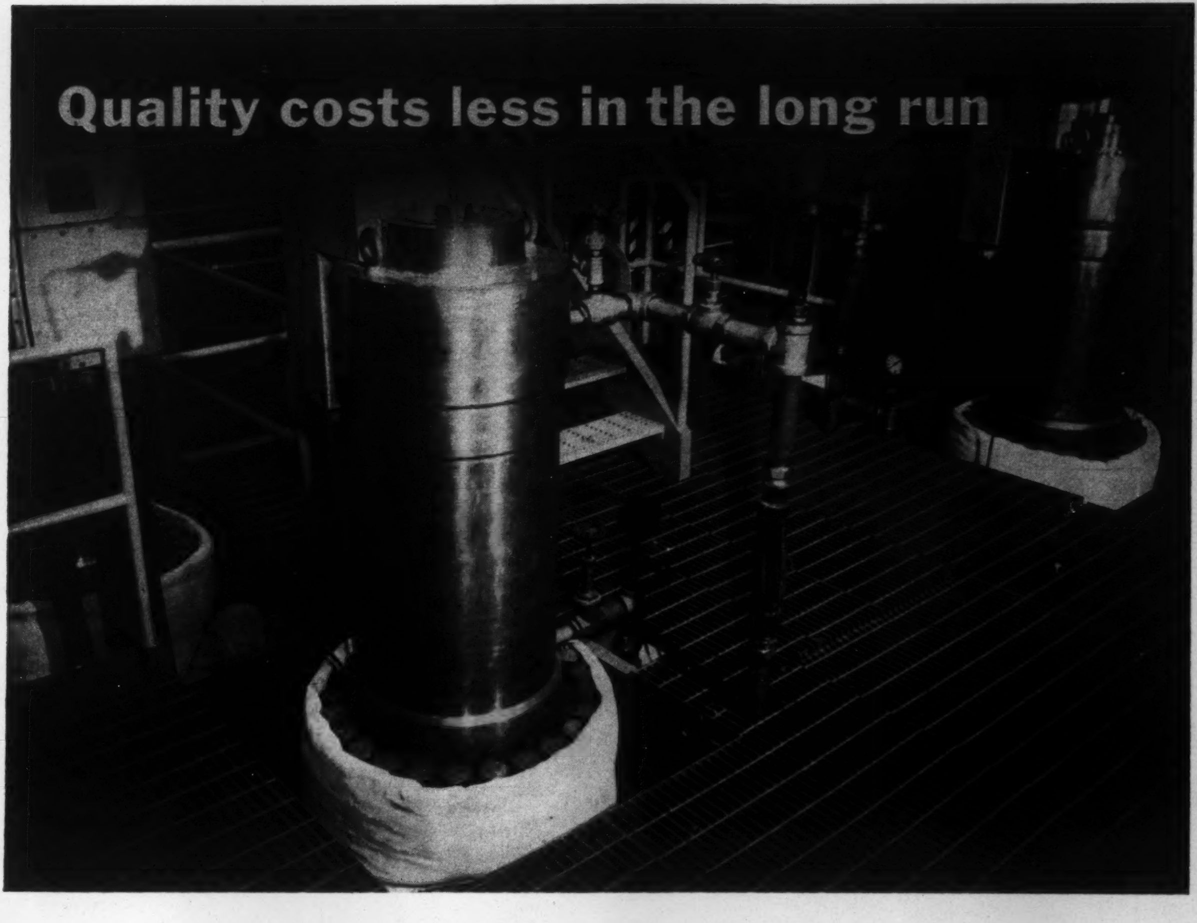
*Spherical, Cylindrical, Ball, Tyson Tapered and REED Miniature Bearings*

EVERY TYPE—EVERY USE

SKF®

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.

*REG. U.S. PAT. OFF.



# Zero leakage nuclear pumps

## Four BJ Liner-Motor Pumps Provide Primary Cooling for AEC's SPERT-III Project

High temperature, high pressure and high capacity performance *with zero leakage* are demanded of these four Byron Jackson Liner-Motor Pumps. Employed to handle pressurized water for primary coolant at the Atomic Energy Commission's SPERT-III project near Idaho Falls, the 500 HP pumps are operating at 650° F, 2500 psig, and are rated at 5000 GPM with a total dynamic head of 350 feet.

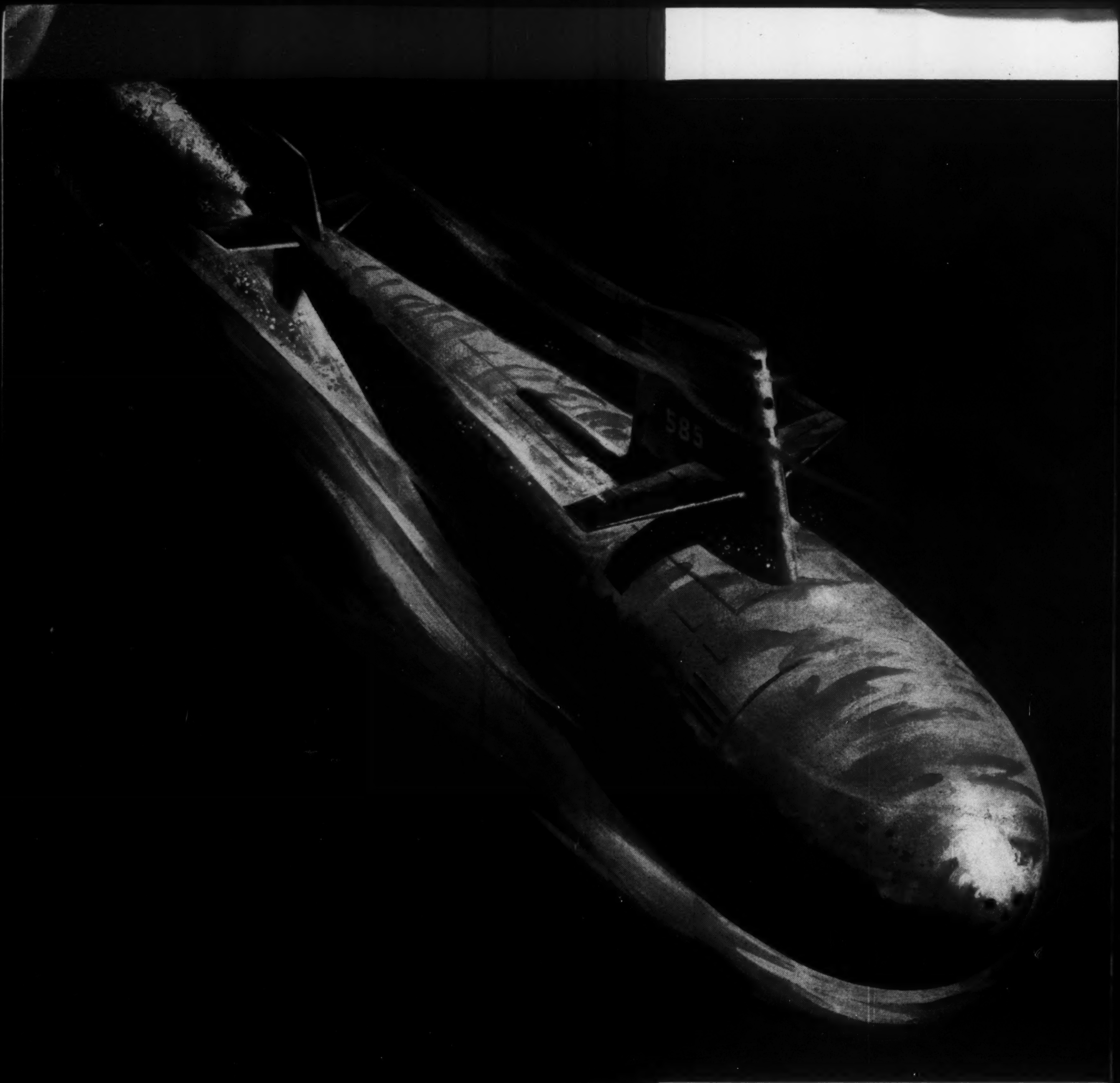
In building pumps to such critical requirements, BJ calls upon the engineering skills and manufacturing methods that have made Byron Jackson a leader in nuclear pumps for all types of reactors...stationary, or portable. The success of BJ nuclear pump design is proved through the installation or specification of BJ Pumps on practically every major commercial reactor in the United States.

BJ quality *does* cost less in the long run!

BJ

*Since 1872*

**Byron Jackson Pumps, Inc.**
A Subsidiary of Borg-Warner Corporation
P. O. Box 2017-A, Terminal Annex, Los Angeles 54, California



**NEW LOOK IN NUCLEAR SUBS . . .** The Navy's new submarine Skipjack, built by General Dynamics Corporation's Electric Boat Division in Groton, Connecticut, features a revolutionary blimp-shaped hull and diving planes on the sail (formerly known as the conning tower). Although her speed is classified, Skipjack is the fastest of the A-Subs.

UNITED STATES PIPE & FOUNDRY CO.

*Steel and Tubes Division*

STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: BURLINGTON, BOSTON, BIRMINGHAM, CHICAGO, CLEVELAND, DALLAS, LOS ANGELES, NEW YORK, [illegible], SAN FRANCISCO

# "HYDROFORGED" FINE-GRAIN STAINLESS PIPE FOR THE NUCLEAR NAVY*

**THE PROCESS:** The starting point is a high quality machined hollow billet made centrifugally which is cold expanded by hydrostatic pressures up to 50,000 PSI in specially designed massive metal dies. After "hydroforging", the pipe is given a recrystallizing anneal which results in the grain refinement characteristic of wrought stainless steel.

**THE PRODUCT:** After final machining of the O. D. and I. D. surfaces to 125 micro inch finish, the pipe is subjected to all the testing requirements of Military Specification MIL-T-18063A (Ships) which covers seamless austenitic steel tubes and pipe intended for radioactive system service. This specification includes: chemical analysis, tensile properties (for Type 304 stainless steel—75,000 PSI minimum tensile strength, 30,000 PSI minimum yield strength, 35% minimum elongation), expanding and flattening tests, hydrostatic pressure test, intergranular corrosion test, macro-etch, ultrasonic and liquid penetrant examination.

*** U. S. NAVY SERVICE APPLICATIONS FOR HYDROFORGED STAINLESS INCLUDE:**

- Pipe for valve operating system reservoirs and primary water preheaters
- Primary coolant piping for nuclear submarines and surface ships
- Seamless welding fitting stock for large diameter reactor piping systems for submarines and surface ships
- Demineralizer shells

PIPE BEING ULTRASONICALLY TESTED IN ACCORDANCE WITH MILITARY SPECIFICATION MIL-T-18063A (SHIPS)

Ljungstrom rotor half is hoisted into place at Public Service Co. of Indiana's 600,000 KW generating station at New Albany, Indiana. When complete, baskets filling the chambers inside the rotors will provide approximately 1,500,000 sq ft of heat-exchange surface. This is one of the eight Ljungstroms being installed to serve four boilers, each evaporating 1,000,000 lbs of steam per hr. The New Albany station is scheduled for completion in 1961.

# BEHIND NEW ALBANY'S **LJUNGSTROMS®** —LIFETIME AIR PREHEATER SERVICE

One of the major reasons why Public Service Co. of Indiana, Inc., chose Ljungstrom for its new generating station at New Albany is Lifetime Air Preheater Service.

Lifetime Air Preheater Service means that Ljungstrom engineers make regular calls *throughout the life of each unit.* They check to make sure your Ljungstroms are working at top efficiency, and that they'll continue to work that way. This service policy covers all Ljungstroms—right from the very first installation made in 1923.

But that's not all. Air Preheater provides first-rate *emergency* service, too. For instance, a Ljungstrom customer in the southwestern U.S. recently called on a Wednesday night for replacement parts. Air Transport looked like the fastest way, but schedules indicated a minimum three-day delivery time. So Air Preheater loaded the parts on a pickup truck, and their men drove them more than 1,000 miles to their destination...34 hours straight driving. The parts were installed and in service by Friday morning.

Fast response to emergencies and regular inspection of Ljungstrom installations are two of the many advantages Air Preheater provides. Another is expert knowledge of boiler and preheater problems gained from over 35 years' experience. Perhaps these reasons explain why 9 out of 10 preheaters sold today are Ljungstroms.

**THE AIR PREHEATER CORPORATION**

*60 East 42nd Street, New York 17, N. Y.*

## basic tool for process measurements . . .

FOXBORO
IN
OUT

# FOXBORO d/p CELL* TRANSMITTERS

Positive overrange protection . . . no perceptible zero drift . . . high sustained accuracy, even under the most punishing operating conditions.

D/p Cell bodies are available in 316 s.s. or rustproofed carbon steel. Unique stainless steel twin-diaphragm capsule is specifically designed to provide positive overrange protection. Purged cover protects transmitter from weather, dust, and fumes.

You can install d/p Cells anywhere — in any position — simply and conveniently, and know they'll give unequaled accuracy and performance. Ask your Foxboro Field Engineer for complete details, or write for Bulletin 13-11A. **The Foxboro Company, 968 Neponset Avenue, Foxboro, Mass.**

### Foxboro d/p Cells for flow, liquid level, and other variables

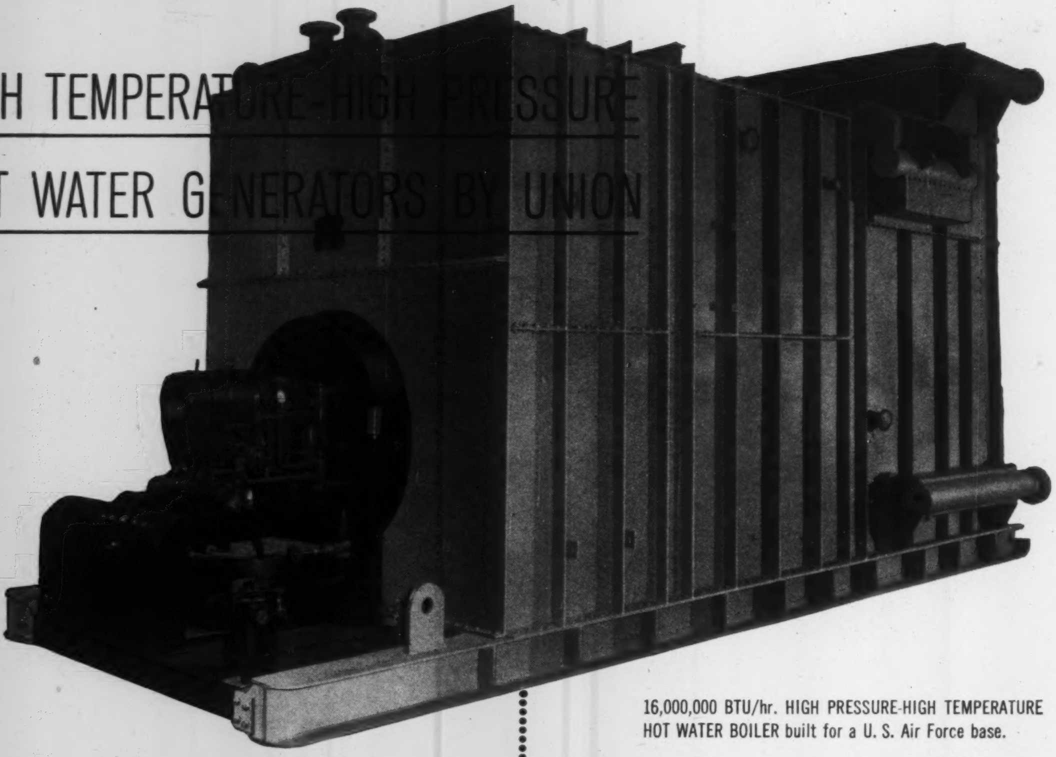
- for high-speed flow measurement and control
- for flow measurement as small as 0.03 gpm
- for flow under static pressures to 6000 psi
- for use where elevated or suppressed ranges are required
- for electronic flow control systems
- for liquid level
- for comparison of process and sample fluids
- for absolute pressure measurement

**Reg. U. S. Pat. Off.*

**Three fully adjustable ranges:**
**0-5 to 0-25 inches of water**
**0.20 to 0-250 inches of water**
**0-200 to 0-850 inches of water**
**Working pressures of 500, 1500, and 6000 psi**

**FOXBORO**
REG. U.S. PAT. OFF.

# HIGH TEMPERATURE-HIGH PRESSURE HOT WATER GENERATORS BY UNION



16,000,000 BTU/hr. HIGH PRESSURE-HIGH TEMPERATURE HOT WATER BOILER built for a U. S. Air Force base.

## SHOP ASSEMBLED UNITS INSTALLED WITHOUT COSTLY FIELD BALANCING

Right from the start, you can save with a Union shop assembled HTHP Hot Water Generator. With all of its circuits of the same hydraulic length, time consuming field balancing can be eliminated. Most units do not require orifices or any other mechanical adjustments to equalize flow at the time of installation.

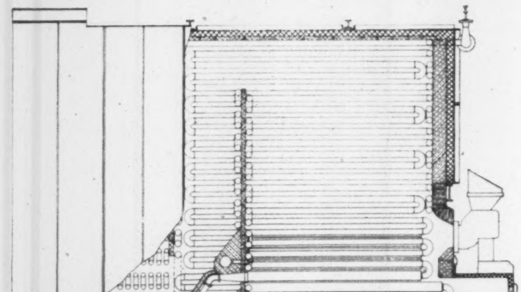
High water velocities (above 5 ft./sec.) and liberally proportioned, water cooled furnaces eliminate localized overheating. As there are no multi-tube circuits in the radiant section, recirculation within a circuit is impossible, thereby eliminating vapor binding or stagnant flow areas.

Liquid and gas flow run counter to each other. With the liquid inlet positioned at the top of the convection section, the lowest temperature liquid is served by the lowest temperature gas. As a result, generator efficiency is improved and the risk of thermal shock minimized.

Standard units (both shop assembled and field erected) can be modified to meet a wide range of job requirements. They can be arranged for firing with most commercial fuels as well as waste fuels in liquid, gaseous or solid form.

For specific information, outline your requirements to a Union representative or contact Union Iron Works.

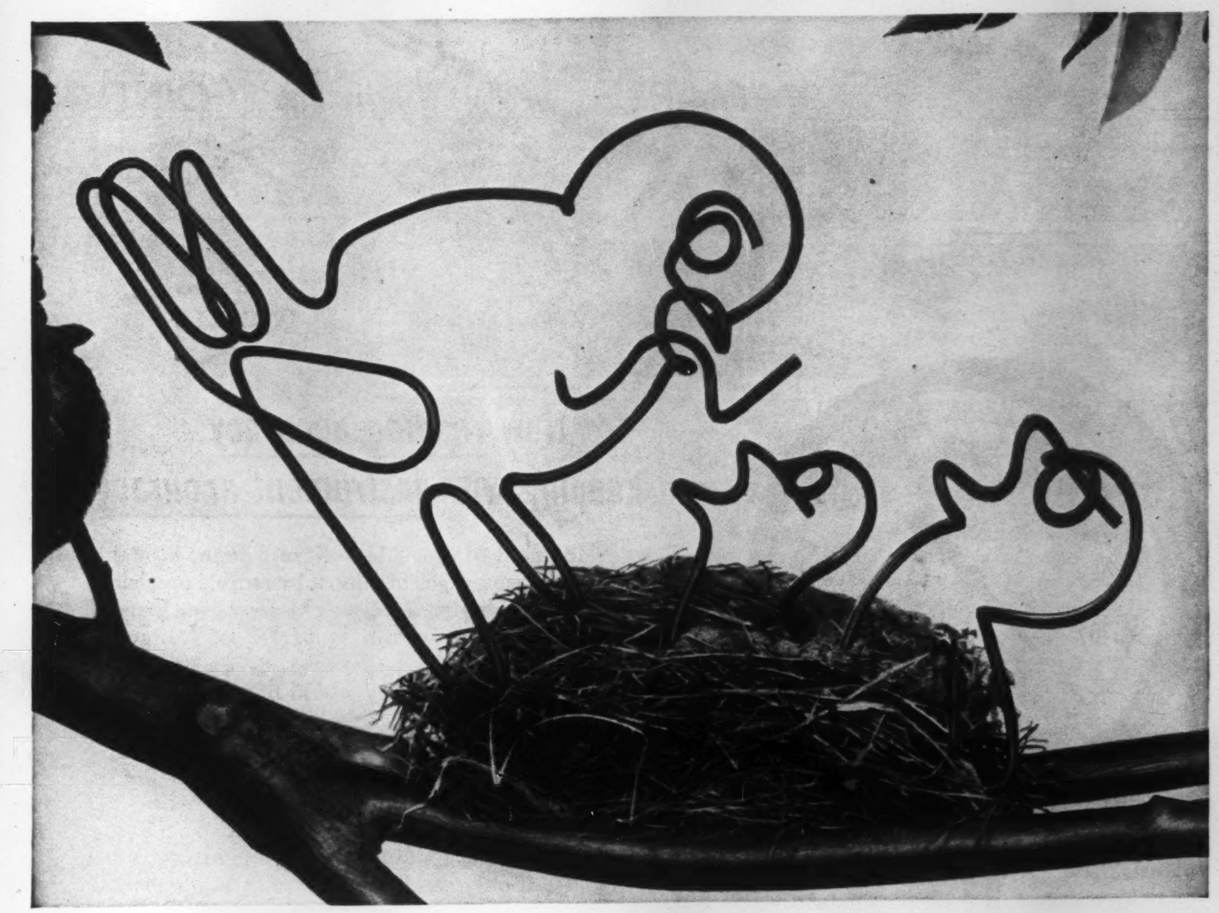
UNION IRON WORKS • ERIE, PENNSYLVANIA



31,000,000 BTU/hr. FORCED CIRCULATION, HIGH PRESSURE-HIGH TEMPERATURE HOT WATER BOILER. Equipped for firing by an oscillating grate spreader stoker with fly ash reinjection. Fully factory-assembled for shipment.

**UNION**

water tube steam generators and allied equipment



# Bundy can mass-fabricate practically anything

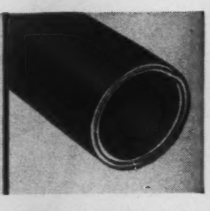
. . . with Bundyweld® — double-walled steel tubing that is adaptable to a whole host of applications.

WHATEVER your tubing problems . . . whatever the stage of development of your product, the Bundy man awaits your call. That's because tubing problems are Bundy's business, and Bundy engineers — with years of tubing experience — can often come up with a design angle that'll save you time and money.

But the Bundy service doesn't end there! Specially designed Bundy machines take over the mass-fabrication of these parts in unlimited quantity. And to meet rigid specifications, we use Bundyweld — the original double-walled steel tubing—the safety standard in small diameter tubing. Thinner-walled Bundyweld is stronger and gives you higher bursting and fatigue strengths. Covered by Government Spec. MIL-T-3520, Type III.

Why not bring your tubing troubles to Bundy and take advantage of expert engineering and design, mass-fabrication economies, and Bundyweld tubing? See Sweet's Product Design File le/Bu . . . or write directly for full information! Bundy Tubing Company, Detroit 14, Michigan.

Bundyweld is the original tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.



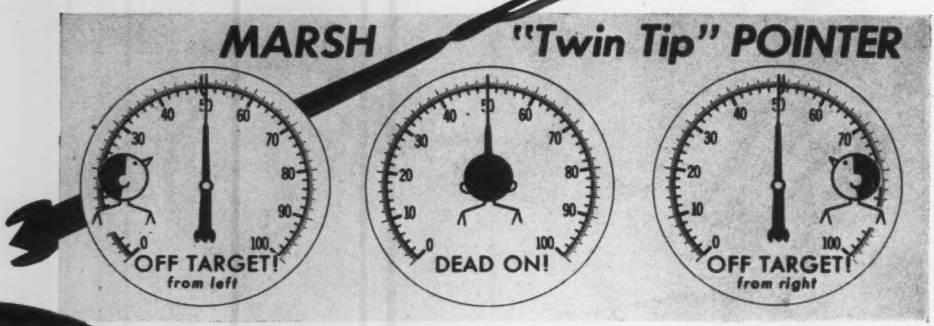
Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high bursting strength. Sizes up to ⅝" O.D.

*There's no substitute for the original Bundyweld Tubing.*

**BUNDY® TUBING COMPANY**

HOMETOWN, PA. • DETROIT 14, MICH. • WINCHESTER, KY.

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, ITALY, JAPAN



Master Test
TYPE 200

# Now *reading accuracy* in keeping with *instrument accuracy*

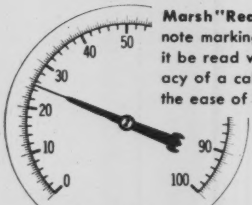
The development of the "Master-test" series brought industry pressure gauges of almost incredible precision . . . gauges individually dead-weight tested . . . gauges guaranteed accurate within ¼ of 1% of full scale reading.

But this extreme accuracy would have been meaningless unless the gauge could be *read accurately*—unless some means were provided for sighting the scale "dead on."

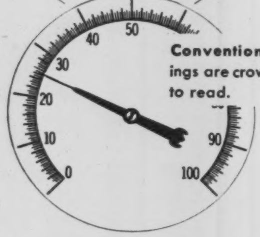
That was the reason for developing the "Twin-tip" pointer illustrated here. With the "Twin-tip" there is no excuse for wrong reading. If two tips are showing you're "off." If only one tip is showing you're dead on the target. It's as simple as that.

The Twin-tip has been declared a real innovation by all who have seen it. In addition to the "Twin-tip", "Master-test" gauges are also available with a Mirror Scale or with a "Non-parallax" scale which also provide reading accuracy in keeping with gauge accuracy. To make reading still easier all "Master-test" gauges have the "Read-easy" scale, illustrated opposite—another Marsh development.

"Master-test" gauges are made in sizes 4½", 6", 8". All standard ranges from 0-15 to 0-30,000 psi. Vacuum and compound types. Full range of case patterns.



**Marsh "Read-Easy" Dial** note markings that permit it be read with the accuracy of a caliper, yet with the ease of a clock.



**Conventional Dial** markings are crowded in—hard to read.

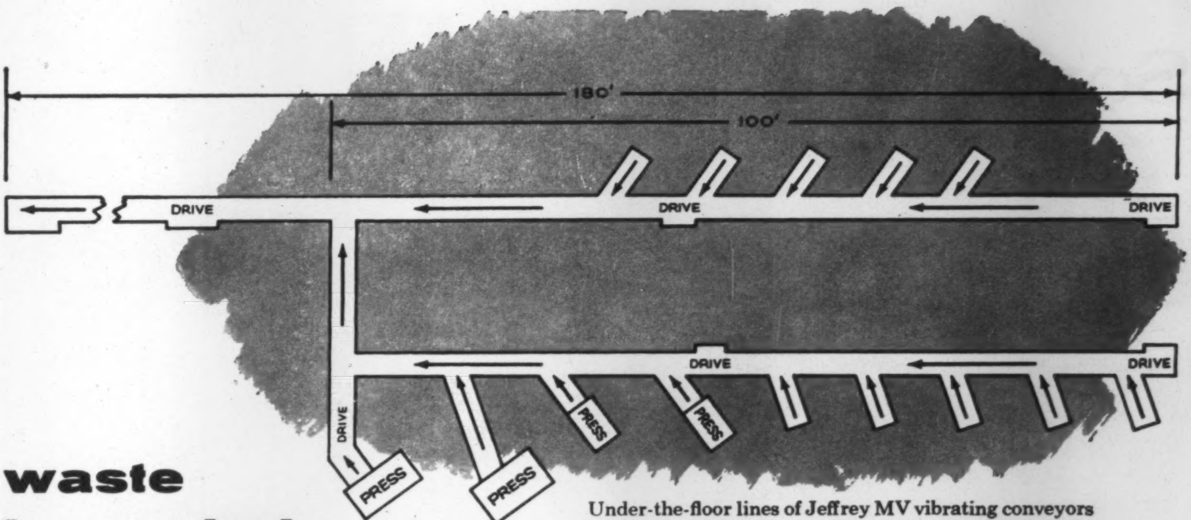
*Ask for this 20 page bulletin*

MARSH TEST GAUGES

**MARSH**

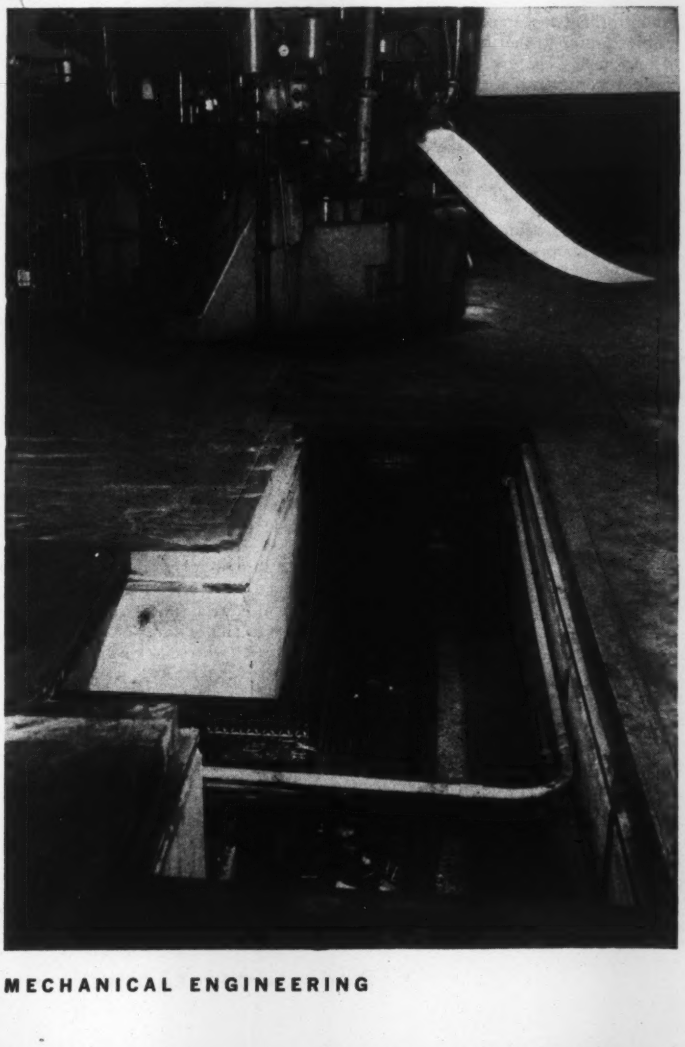
"THE STANDARD OF ACCURACY"

**MARSH INSTRUMENT COMPANY, Dept. 29. Skokie, Ill.**
*Division of Colorado Oil and Gas Corporation*
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas



Under-the-floor lines of Jeffrey MV vibrating conveyors at Motorola, Inc., Arcade, New York, carry waste away from the punch presses as fast as it is produced. Engineered by Conveyor Systems, Inc. of Chicago.

# waste is carried along smoothly, quietly on the JEFFREY MV CONVEYORS



MOTOROLA's punch press department, with its fourteen busy presses, is kept neat at all times. Metal trimmings and punchings from the presses fall directly through chutes onto Jeffrey vibrating conveyors below the floor. These keep this waste moving toward the end of the building, where a bucket elevator lifts it to an overhead bin, to be hauled away.

Jeffrey MV conveyors move material *fast*, lifting it from the deck with a rapid forward motion; no sliding action to cause wear. They are simple in design, dependable in operation and rugged in construction, so they're economical to operate and low on upkeep.

Bulletins describing Jeffrey mechanical conveyors of all capacities—light, medium and heavy—are available. For copies, write The Jeffrey Manufacturing Company, 915 North Fourth St., Columbus 16, Ohio.

**JEFFREY**

CONVEYING • PROCESSING • MINING
EQUIPMENT... TRANSMISSION MACHINERY...
CONTRACT MANUFACTURING

# Some Ideas

for your file of practical information on drafting and reproduction . . . from **KEUFFEL & ESSER CO.**

Papers, in their special way, are as different as people . . . and choosing the best paper for a specific job can be as difficult as choosing the best *person* for the job. Here at K&E, we try to do the work for you, by painstakingly determining precisely the characteristics required, then refining them to the point of excellence. Here are some good examples:

### A New Type Of Typing Paper

Translucent typewriter papers are very popular of late for typed originals from which numerous copies must be made. The savings are considerable when you use translucent originals through diazo reproduction—savings up to 80% in many cases. But most translucent papers used today stand erasure very poorly. Recognizing the inevitability of human error, K&E has perfected a better translucent typewriter paper called TYPEMASTER® (193)—the perfect answer for those whose typing is less than perfect. TYPEMASTER's completely new, *engineered* surface affords outstanding erasability. A thin, unusually tough coating, it readily catches and holds the typewritten image, yet resists penetration of the ink into the paper fibers . . . and therein lies the secret of good erasability. A number of skeptics who tested the new TYPEMASTER sheets have now discarded all others. Skeptical or not — may we suggest you try it.

TYPEMASTER
ERASES
PERFECTLY

### Tracing Pads "To Travel"

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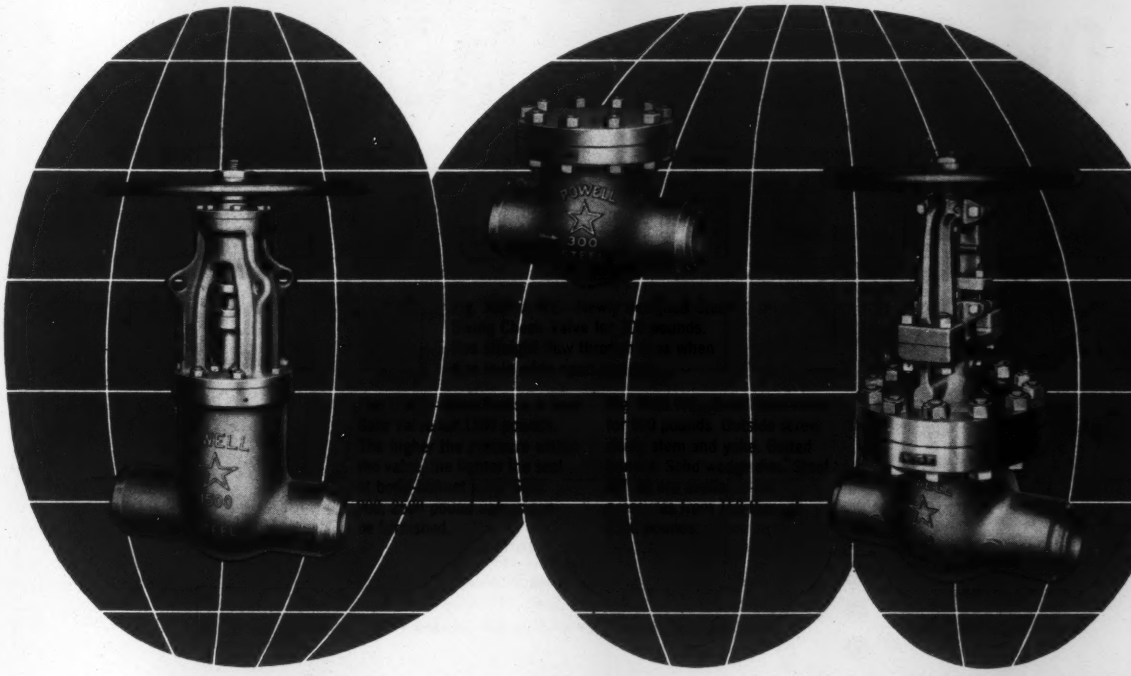

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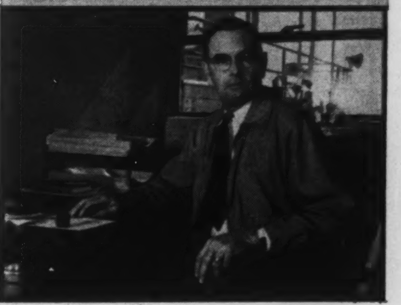

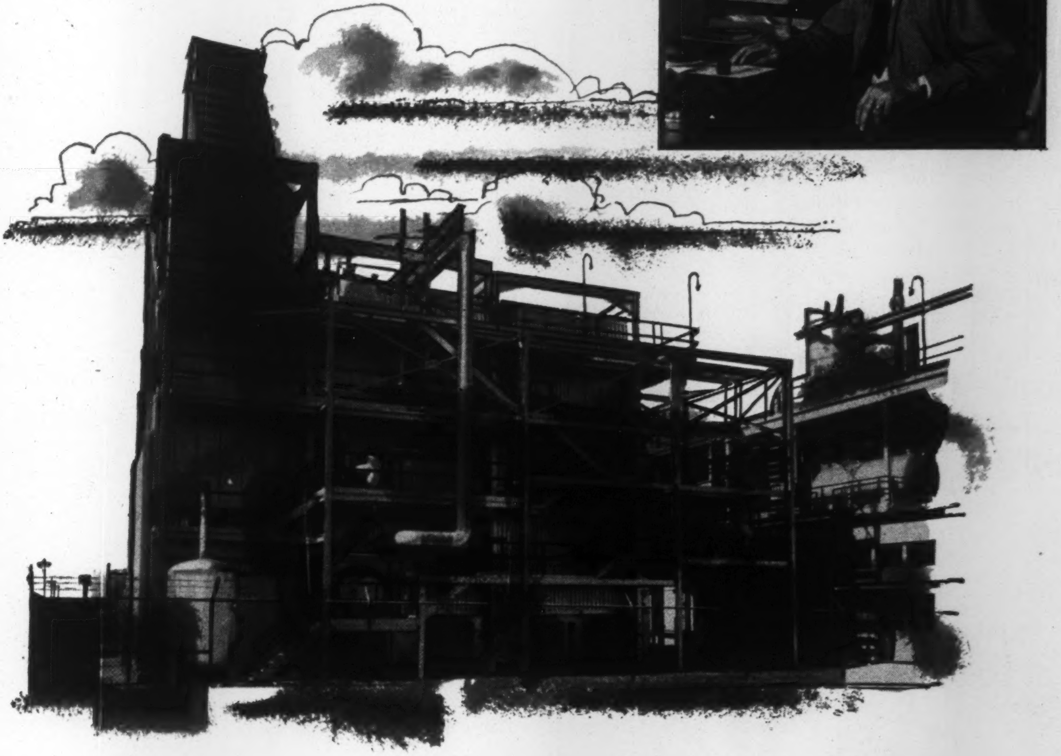

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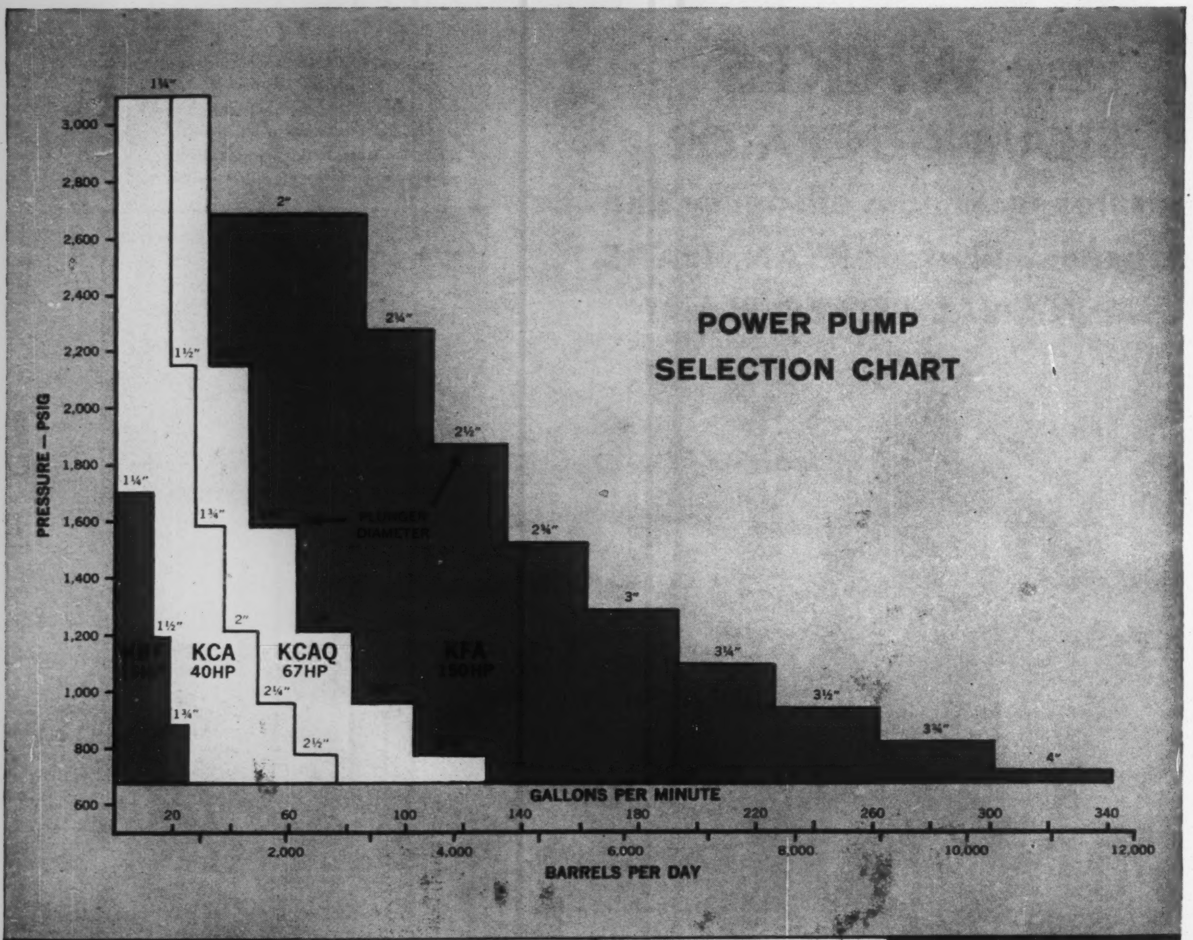

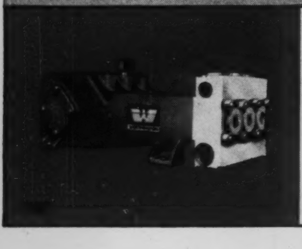

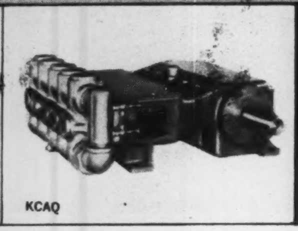

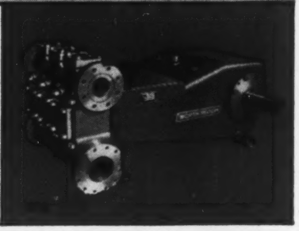

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**WORTHINGTON**

MECHANICAL ENGINEERING

VOLUME 82 • NUMBER 8 • AUGUST, 1960

# A Memorable Day ?

**Editor, J. J. JAKLITSCH, JR.**

The day they set the cornerstone of the United Engineering Center should have been a memorable day. More than 300 representatives of the various societies and their guests sat in temporary stands set up outside of what will be the Center's entrance on New York's 47th Street (see "The Roundup," this issue). It was a bright sunlit afternoon and a slight breeze blew in from the East River across United Nations Plaza and whisked gently over the heads of the attendees and on through the steel structure which forms the skeleton of the new Center.

Yes, it should have been a memorable day. On hand to help set the cornerstone were New York's Mayor Robert F. Wagner, and former President Herbert Hoover. As the Mayor so aptly put it: "Our tribute is not to a building because it will enhance the skyline of our city but because it will accommodate a class of professionally trained men and women who are dedicated with a common, unselfish interest; the benefit of their fellow man.

"To them, in a large measure, we owe our day-to-day safety and many comforts and conveniences that . . . we are likely to take for granted."

The Mayor said it well, for never was there a time when the engineer was proving himself to be more and more useful, more valuable, both as a citizen and as a dynamic force in this age of engineering advancement. In fact, as the United Engineering Center's slim tower of glass and steel rises, one can look upon the structure as a growing tribute to all engineers.

Indeed, that warm sunny afternoon in June should have been a bright occasion. And it was for many. Yet for the ASME Member Gifts Committee, it was not so bright. Certainly, the building is going up, materials and equipment are on order, office floor plans are on paper, and the work schedule calls for completion by mid-1961. But many members of ASME, in fact more than 30,000, have not as yet made a contribution. And ASME still needs $110,000 to meet its quota. As President Walker Cisler said in an address at the 1960 ASME Summer Annual Meeting (see pages 36–38, this issue), "Our sprint appears to be in danger of running down more than $100,000 short of the mark. It is time to get our second wind and forge ahead to the tape.

"Out of ASME's 92 Sections only 22 have reached or exceeded their quotas. Our other Sections are still behind and lagging in the homestretch. So far this year, only 12 of them have obtained an additional five per cent of their quotas and 48 have added less than one per cent.

"ASME Members have not as yet fully assumed their just share in the cost of this undertaking, which will serve us so well and represent our profession so effectively. The United Engineering Center will be the home address for distinguished societies dedicated to our mutual professional development and our service to our fellow men."

So, it's up to you, the individual members of ASME. By meeting the challenge, forging ahead, and fulfilling your obligation—100 per cent of the quota or better—the day the UEC cornerstone was set may yet be a memorable one for the Society.—*J. J. Jaklitsch, Jr.*

**OUR WHOLE NATION SEEMS TO BE FEARFUL!**

*Men don't fear what they understand and can master. "Human engineering" may produce some of the answers we're seeking. Call it "operational mastery"*

**By Harold Grasse,**[1] Vice-President, Region VIII, ASME

# AN ENGINEER LOOKS AT HUMAN

In a recent news conference, President Eisenhower was asked about the missile race between this country and Russia. He used the word "hysterics" in his reply, to the effect that many of us are reacting in a hysterical manner to even small crises. We all know that clear, level-headed decisions cannot be made in this sort of atmosphere.

Our whole nation seems to be fearful. Fearful of what? We are fearful of the unknown, and how it might hurt us.

Once upon a time gunpowder did not exist. We lived and worked in a state of blissful ignorance. Then suddenly it was upon us, this deadly new thing, and we rose rapidly to a new state—one of hysterical fear. Then we learned to use it, defend against it, understand it, and realize its limitations. With this new knowledge we let down from the level of hysterical fear to a new steady state of operational mastery. In this state, we use it and we respect it; we no longer fear it.

So it is with each new weapon that comes on the scene. First, a state of blissful ignorance; then, hysterical fear; and finally, operational mastery.

### Our Present Condition

Where are we as a nation right now? We are definitely in the second, or hysterical-fear, state. And why? Because there are so many things that we know of that could hurt us. It's as simple as that. We fear those things that we haven't yet learned to control or to protect ourselves against.

The radical differences of opinion recently expressed by our joint Chiefs of Staff and by other military people, relative to the kind of weapons we must have if we are to survive a Russian attack, caused most of us to stop and think. Is the antimissile missile our only hope of survival? Is the Dew Line our only hope? How much time will we have?

Hitler, in "Mein Kampf," told what he was going to do, and when, and he almost did it. Most of us read the book *after* the war. Now a Russian has said that the United States will be conquered from within. What does he mean—sabotage? revolt? revolution? One doubts it. Too much risk of failure, of partial success.

The Russians can read history as well as we. Have not the great civilizations of the past fallen because their tax burdens became too great to bear? Like us, they were steam-heated, air-cooled, wheeled-vehicle driven, heavy with luxuries, full and complacent. They, too, had an easy credit system, and storehouses full to overflowing. Their major decisions, also, were being made by their Governments.

And what happened to them? They fell—hard. Actually, their foundations rotted away and they collapsed. Could we be approaching something of the same fate?

We are in the missile race up to our ears. Every day or so we are told of another great Russian advance or achievement. We are frightened nearly out of our wits, and with what little we have left we vote more billions for more defense. Are we that sure of what the Russians have? We have only Russia's word for it. Don't you remember when you were a kid that a great big shadow could be created with a little tiny object if the light were held just right?

Let's do some imagining. What would happen if Khrushchev, at this moment, were to broadcast to the world this message:

"Americans. Your national debt is now equal to your national income. You must have war to save your economy. We Russians do not want war. We want only peace. Our scientists have great strength, so have yours. Now we will tell you our secret. We got nowhere near the moon with our Lunar shot—neither will you. Our cameras took pictures of the dark side of a moon—the moon we built in our Moscow laboratory. But you believed our propaganda.

"Now hear this. The cold war is over. We are lifting the iron curtain forever. Free trade, free commerce, free travel for everyone."

Just supposin'! How many hours would it take for the United States of America to crumble from within—

---

[1] Kansas City, Mo.

Condensed from an address delivered at the Welcoming Luncheon, Rice Hotel, Houston, Texas, of the Gas Turbine Power and Hydraulic Conference, March 6–9, 1960, of The American Society of Mechanical Engineers.

# BEHAVIOR

economically? No DEW system will guard against this kind of enemy.

What will? I submit that the mind of the engineer will. Our salvation lies, not in strength of walls, but in the strength of minds.

### The Real Trouble?

Let's do a little more imagining. Could it be that we are guilty of a childish thing—that we are afraid to admit that someone might have something bigger or better than we have? Could this possibly be our real trouble?

The conditions in the world today, the unrest, the hatred, the strife, the envy, are not somebody else's problem. They are not in the abstract, over there someplace. They are right here, right now.

In my town, on January 28, a bomb caused great damage to our newest synagogue. Swastikas were painted on it and on other Jewish temples. Teenagers, members of Hitler Revival Groups, were involved.

World trouble? Not world trouble; people trouble. The-guy-who-lives next-door-to-me trouble.

Will an ICBM, or antimissile missile, or great fighting forces solve his problems? Or yours? Or mine?

Where do world problems come from? From the same origin as family problems—from greed, selfishness, envy, hate. Just as long as the individual possesses these things, his family, his town, and his nation will possess them, and all of us, the world over, will cringe in fear from the unknown.

You and I know that the laws of physics and chemistry will continue in the future as they always have. We know we can count on them. We can design and project our planning accordingly. We don't fear them, because we understand and accept them.

### Laws of Human Motivation

Isn't it conceivable that human actions also follow certain laws? The fact that we don't know what these laws are, doesn't prohibit the existence of such laws.

When physical scientists predict certain behavior characteristics of a new substance, as the Curies did, they are respected for their prognostication and praised for their research. But when other scientists predict human behavior patterns, as the prophets of old, they are hailed as mystics, as freaks, or worse. Isn't it possible that both scientists are dealing with laws that are finite? In the one case, most of us know what they are; in the other case, only a few know them.

We are prone to disbelieve those things which we cannot see or feel or hear or smell. Doubting Thomas has many, many descendants.

We might have the answer to many of our problems if we just understood people better. When we look below this thin veneer of civilization which covers us, we find that psychologically we are just where we were 2000 years ago. The same doubts and uncertainties confuse us that plagued people then. In spite of our Savior's teachings, we have not yet learned to get along with our fellow man. The time has come for us to search out those laws which govern human behavior and apply ourselves to the understanding of those laws.

Engineering in the field of human behavior is just beginning. Our success or failure as a nation may rest on our understanding of this subject.

To illustrate the point: What effect does each of the following have on the over-all productivity of any creative engineering group: Praise, environment, hours, pressure, rules, happiness, appreciation, loyalty, confusion, communication, incentive?

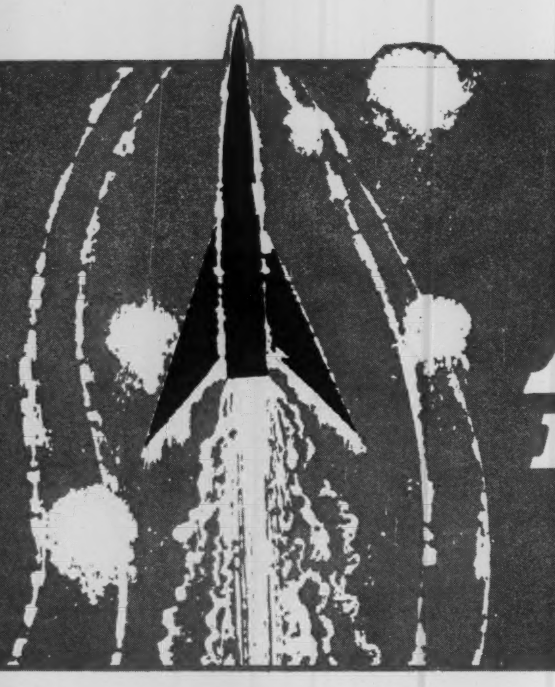
You will note that none of these bears a $ sign. These are in the areas of human engineering—knowledge of which can mean dollars to the employer, peace and happiness to the employee.

Before we attempt to colonize the moon, I hope we will know more about people on this planet.

The salvation of this country and our world is the mind of the engineer—turned this time toward construction, not destruction; toward man's mind, not man's possessions; toward belief in God, not belief in man; toward conquering fear, not causing it; toward an understanding of human engineering.

Gunpowder can surely kill us. So can fear. Let us then learn to control fear as we have learned to control gunpowder.

Truth is the vaccine for the fear virus. "Operational mastery" is our goal.



*At the mid year, President Cisler reports to*
*Here are the high lights of the President's*

# ASME Looks to

ASME is a complex and dynamic organization with 92 sections across the country. It has been wrought into what it is today by the personal participation and teamwork of our many talented engineers.

### Organization Structure

A brief word about the administrative core of our organization, the central headquarters. Those of us who serve you in elective or appointive capacities have special opportunities to observe the magnitude of that operation. Our Secretary, Mr. O. B. Schier, II, and his staff deserve our special commendation for our Society's effective daily operation, and for the continuity of operation over the years.

The office is organized into five services—Technological Service, Codes and Standards Service, Field Service, Publications Business Service, and Personnel and Office Service.

Our permanent staff has a constantly increasing background of experience in the affairs of ASME. To make the best possible use of the proved ability of our Secretary and his key personnel, we would be well advised to consider the reorganization of some areas of responsibility that now rest upon active members selected on an annual basis. Some of these duties certainly could be assigned to the permanent staff, strengthening ASME and preparing it for growth in the years ahead.

### Membership Problems

The future growth of ASME depends upon our ability to retain our active members and to secure as many qualified new members as possible from year to year. This, in turn, depends largely upon the extent of activity at the sectional level.

What can we offer the engineer just out of school, or the engineer five years later, or many years later, that will make ASME and our activities in his area an essential part of his professional life?

Our programs and activities at the sectional level satisfy the psychological needs of potential members, offering the new engineer friendship, orientation, and a chance to participate; offering the young man of somewhat longer experience opportunities to expand and to deepen his understanding of ASME through leadership activities and through an ever-widening circle of professional friendships. In turn, the engineer with more years of experience can take over greater responsibilities and wider contacts within the community and the profession, while giving more of his attention to the needs of the younger men.

During the past 15 years our combined regular membership has increased some 28,000. Including an annual enrollment of nearly 12,000 students, the total membership is now about 60,000. This is an impressive number.

Nevertheless, there is reason to believe that we are not attracting or holding a sufficient number of the younger men who are our principal source of future growth.

During 1959 about 8500 mechanical engineers graduated from institutions with curriculums accredited by the Engineers' Council for Professional Development. Only 67 per cent of these had been ASME student members on the campus. Upon graduation 51 per cent had completed the requirements for promotion to Associate membership, but only 2850 or 33 per cent actually paid their first dues. At least 5500 men out of 8500 are entering the profession this year without joining the Society.

Our records show that every year some 2000 members are removed from the rolls of the Society for nonpayment of dues. Who are these men who drop out? Most of them have been in ASME from one to five years. Why do they leave?

---

The author is president, Detroit Edison Company, Detroit, Mich.

Based on an address delivered at the President's Luncheon of the Summer-Annual Meeting, Dallas, Texas, June 5–9, 1960, of The American Society of Mechanical Engineers.

*the membership on the problems and trends of the Society.*
*address to the Summer Annual Meeting at Dallas.*

# the Future

**By Walker L. Cisler,** President, The American Society of Mechanical Engineers

At recent meetings of the Council, this problem has been discussed, for it is evident that there must be significant reasons for such attrition. The Board on Membership has a preliminary report on this matter and is now engaged in an attempt to find solutions.

However, this is in many ways a problem that cannot be delegated completely to a study group. It is our problem, in our own sections, and I am thinking especially of the young mechanical engineers who graduated in June. While the study is progressing—and it is certainly a most valuable study because it is nationwide—we ought to get busy at home, making a special endeavor to welcome the newest graduates into the sectional organization, stimulating junior committee activities, encouraging professional development for the young men, listening to them, helping them, asking them to help us, and planning our programs with them in mind. We must be intuitive and creative in these matters.

### Professional Unity

The need for some form of unity organization has been apparent for years. In 1949 James F. Fairman of The Consolidated Edison Company, who was then president of AIEE, stated the need very well. He said:

"I suggest that our emphasis should be on the oneness of the profession, not only on the fact that our approach to problems, our method of attack, our processes of analysis, our fundamental technology are something we hold in common, but that our problems in the social, economic, and political fields, resulting from our own technological achievements or from external factors, are matters to which the attention of a united profession should be directed."

In June, 1956, the Board of Directors of AIEE adopted a proposal regarding the organization of the engineering profession that has since come to be known as the Functional Plan. It recommended that a clarification and division of labor should be achieved by three important organizations, The Engineers Joint Council, the Engineers' Council for Professional Development, and the National Society of Professional Engineers, a membership organization closely related to the state bodies of professional engineers.

The essence of the Functional Plan was that EJC should concentrate on technical activities, ECPD on educational activities, and NSPE on professional activities, eliminating duplication of functions. It was believed that this arrangement would achieve an important degree of unification, a step in the right direction.

The present situation is that ASME and several other societies favor the simple Functional Plan with no change in the organization of the individual member societies, no change in the relationship of these societies to their joint organizations of ECPD and EJC, and no change in the relationship of the state professional engineering bodies to NSPE. It is intended that each of these organizations should act in the educational, technical, and professional areas, respectively, in accordance with their present charters and constitutions.

It is further the intention that individual member societies are not to be limited in any way in their present services to members and the profession, although they may delegate duties if they wish and if it is legally feasible.

This plan is said to be opposed by several societies that favor the merger of ECPD and EJC with the formation of the American Engineering Association and then the reseparation of ECPD and EJC as divisions of the Association. This in turn would have a separate board of directors with effective power. The Association would be a new body between the individual member societies and ECPD and EJC. Relationships between the Association and NSPE would be effectuated by a co-ordinating council.

Although both plans are rational and have desirable features, ASME has favored the first plan, which is

# ASME Looks to the Future

simpler, widely acceptable, evolutionary in its approach rather than drastic. On the other hand, the prerequisite of real unity is acceptance by all engineering societies.

### United Engineering Center

As we proceed toward a functional unification of the societies, a fitting symbol of our mutual purpose is under construction in New York City on the United Nations Plaza.[1] This is the United Engineering Center, a joint undertaking of the engineering societies, valued at $12 million and worth much more than that in the long pull ahead to our profession.

Every sunrise that enriches the beauty of the United Nations Building marks new progress in the construction of the edifice that will soon provide quarters and joint facilities for ASME and other engineering societies. Steel is going rapidly into place.[2]

In a few years engineers from all over the United States and, indeed, from all over the world, will gather here for conferences and committee meetings. It will be the home address for distinguished societies dedicated to our mutual professional development and our service to our fellow men.

I regret to have to report that ASME members have not as yet fully assumed their just share in the cost of this undertaking, which will serve us so well and represent our profession so effectively in the eyes of all who visit or who have official missions to perform in New York City. It is true that we have achieved 85 per cent of our $800,000 quota, yet we still need another $116,000 to fulfill our obligation.

Reports from the Capital Gifts Campaign show that many members have not been approached except by a routine letter. Personal contact in many of these cases has already produced gratifying results.

The average contribution to date is $49, with more than 30,000 members still to be heard from. We must remember that the Member Gifts Campaign is being conducted with the approval of the membership of ASME. If the members do not fulfill the obligation incurred in their behalf, the Society will have to make up the deficit from its own resources or by a general assessment of some kind. This should be a last resort and one that I am sure will not be necessary if the Sections will make special endeavors to reach each member personally.

### International Relationships

Over the years it has been my good fortune to work with men in many nations, both as a matter of personal endeavor and on governmental and industry assignments. I have found that engineers everywhere have a common basis of understanding that is based upon technical knowledge and professional ideals.

One of my purposes in accepting the presidency of ASME was my deep desire to help in the building of more constructive international relationships for our Society, similar to the fine ties of friendship and mutual assistance that exist between ourselves and our colleagues in Canada, England, France, Austria, and others. (In June, ASME was represented at the centennial of the Austrian Engineering Society, to which we sent official delegates.)

A year ago I made it my purpose to contact personally, as an engineer and as a member of ASME, the engineering societies in France, Austria, and Poland and, to a lesser degree, in the Soviet Union.

It will be important for ASME to establish helpful relationships in other parts of the world that most of us, from force of habit, still call distant—in Indonesia, for example, where President Sukarno himself is a civil engineer, and particularly in some of the younger nations in Africa. We can be sure that engineers in these countries will welcome technical assistance and management and an interchange of personnel with the more developed industrial nations.

There are two international events approaching, one in Europe and one in South America, that are of special significance to us. One is the 1960 General Assembly of EUSEC, the Conference of Engineering Societies of Western Europe and the United States of America. This encompasses associations in Belgium, Finland, France, Western Germany, Great Britain, The Netherlands, Norway, Switzerland, and of five societies in the United States, one of which is ASME. We will be represented at that conference in Brussels in late August.

Through Engineers Joint Council we are also associated with UPADI, the Pan-American Federation of Engineering Societies, which will hold its seventh convention in the middle of September in Buenos Aires. ASME will be represented directly on that occasion, too.

UPADI (Union Panamericana de Asociaciones de Ingenieros) came into existence when the engineers of the South American Association of Engineering Societies decided to broaden their activities to embrace the entire western hemisphere, with the purpose of facilitating personal and technical relationships and standards between South and North America, the western hemisphere. This may well become a very productive development of mutual interests to which ASME can make a significant contribution.

### The Task of the Engineer

The upgrading of natural resources for the support of the world's rapidly increasing population is the task of the engineer—and I do not have to tell this group what a complex endeavor this is or how its magnitude will increase with the passing years. If all men are to have opportunity, then technology must spread over the world to correct, as much as possible, the imbalances that now exist in respect to population, natural resources, energy, and machines—imbalances that are the cause of many of the instabilities evident in the affairs of nations.

To do this task well, engineers must integrate their endeavors with the help of societies like the ASME. If they are to function effectively in the world at large, their integrity, prestige, and professional ability must be firmly established in the minds of all who will work with them and of all who will need their assistance. Amid the diversities of language and culture, even today the role of the engineer and his ways are within the comprehension of all men.

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[1] The cornerstone was laid June 16, 1960. See "The Roundup," this issue.

[2] Steel construction is expected to be completed this month.

# PACKAGING AND HANDLING OF PRECISION INSTRUMENTS

**By Arthur Bleimeyer, Jr.**[1]
ACF Industries, Inc., Houston, Texas

*Note: Use shock-absorption materials on tables, trailer decks, and storage shelves Special training of personnel is indicated.*

THE success or failure of many of today's manufactured items is dependent upon the accuracy and dependability of precision electronic control instruments. This is especially true in the case of aircraft and missiles. Because of their highly specialized nature, most manufacturers purchase these instruments rather than build their own. Since this frequently involves shipment over long distances, the problems associated with proper handling begin in the supplier's factory.

Personnel handling these items frequently are not conscious of the damage that can result if such an instrument is dropped a distance of only 1 in. Tests in which an Impact-O-Graph recorder was dropped from distances of 1, 2, and 3 in. above the table recorded acceleration forces ranging from 10 to 20 *g* depending upon the distance from the table top.

### Shipping Problems

It is quite obvious that the user of the instruments must maintain close contact with his supplier to insure adequate protective packaging of the instrument in the supplier's plant. He may find it necessary to conduct his own investigations into this problem and write rigid specifications for his supplier to follow. Many materials and techniques have recently come into prominence which are designed to minimize handling problems. In general, packages utilizing form-molded fiber (or rubber) materials conforming to the size and shape of the instrument being packed have been found quite successful.

To be certain that the instrument will receive adequate care and attention once it arrives in the user's plant, the package containing the instrument must be identified in such a way that its contents will be readily known to the employees in the Receiving Department. Standard means of product identification should be included in the packaging specifications prepared by the user and should continue to serve its purpose during the entire time that the instrument remains in the user's plant prior to its final installation in the equipment for which it was purchased.

### Training Employees

The user of the instrument has an important function to perform involving employee training—he must be certain that any employee who might have occasion to handle the instrument in his plant recognizes the importance of cautious handling. Many plants have found that this fact may be impressed upon in-plant personnel simply by having a large price tag attached to the instrument or its container. Special training sessions are advisable.

Before the packaged instrument is permitted to leave the receiving area of the user's plant, it should be given a thorough inspection by personnel specifically trained for the execution of this important function. Claims should be filed promptly in the event that damage has occurred during shipment due to carelessness on the part of the carrier. The receiving inspector should also check to see that the supplier is conforming with the packaging specifications established by the user. Failure to conform with these specifications should be reported immediately to the supplier and a predetermined penalty assessed against him. The terms of the packaging specifications should be a part of the sales contract.

### Handling and Storage

Normally, instruments are delivered to the user's plant before they are actually needed and suitable handling and storage facilities must be provided in the interim. Each user of such instruments should conduct a thorough study of this twofold problem in order to determine what facilities will best satisfy his requirements.

The personnel performing the receiving and inspection functions in the user's plant are usually the first to have occasion to handle such items. The tests in which instruments were dropped distances of 1, 2, or 3 in. pointed up the need for adequate shock-absorption materials on the tops of tables, work benches, and storage shelves where such instruments are normally handled. Further studies indicated that in this particular application a 1-in-thick sheet of polyurethane possesses shock-absorption characteristics superior to a $^3/_4$-in. thickness of felt or a 2-in. thickness of polyurethane. As a result of these tests, steps were taken to provide such product protection on the surfaces of tables, benches, and storage shelves.

### In-Plant Transportation

The next phase of this investigation involved a thorough study of the in-plant transportation facilities. The instruments were transported from place to place within the plant on four-wheel trailers pulled by a small truck. Once again an Impact-O-Graph recorder was used.

This was first placed on the bottom deck of a trailer equipped with spring-mounted casters and hard-rubber tires. The recorder was alternately placed on sheets of $^3/_4$-in. felt, 1-in. polyurethane, and 2-in. polyurethane and the trailer was pulled through the plant in the usual manner. Best results were obtained when the 2-in. sheet of polyurethane was used.

Similar tests were conducted with the hard-rubber tires replaced by pneumatic tires. Surprisingly, less favorable results were obtained and the use of hard-rubber tires was continued.

A number of other tests were conducted in which the conditions were varied slightly, but the best results were obtained when the Impact-O-Graph was placed on a 1-in-thick sheet of polyurethane laid on the top deck of a three-deck trailer which was equipped with spring-mounted casters and and hard-rubber tires.

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[1] Manager, Manufacturing Methods and Standards, W-K-M Division.
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# AIR HEATER

*The conception, design, and operation of a heater to raise*

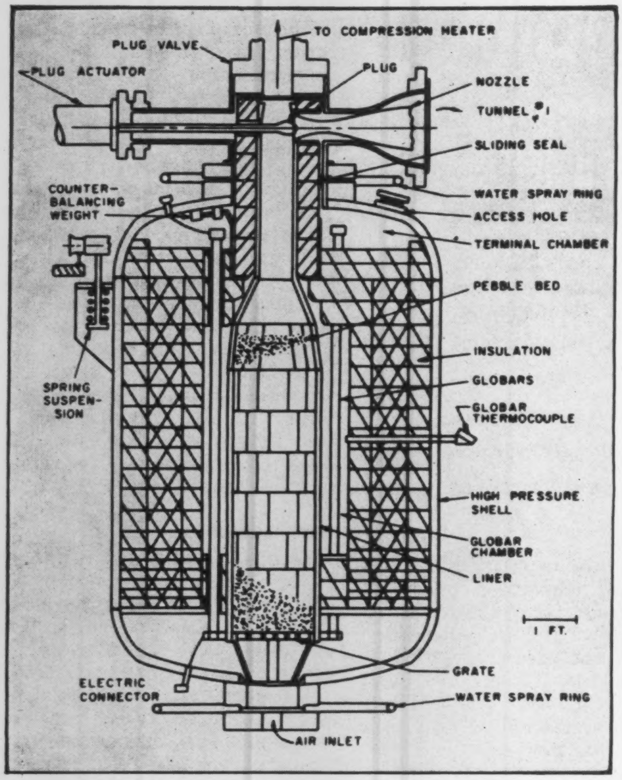

**Fig. 1** Twelve Globar heaters are arranged around the periphery of the bed at 9-in. intervals to insure maximum lateral uniformity of temperature in the bed in the fully heat-soaked condition. The space provided around the Globars makes radiation the primary heat-transfer mechanism.

Quantities of heated pressurized pure gas, intermittently supplied, are needed for research and manufacturing purposes. In particular, they are used in operating subsonic, supersonic, and hypersonic intermittent wind tunnels when it is necessary to partially simulate flight temperatures and pressures, or to prevent condensation in the test section.

## Convection Heater

A heater which raises intermittent charges of pressurized air or other gases to temperatures in the neighborhood of 3000 R, without adding to them contaminating substances like carbon dioxide, moisture, or solid particles, has been constructed at BPI's Aerodynamics Laboratory, Figs. 1 and 2. The heat exchange is accomplished by forced convection from a heat-storing bed of refractory pebbles, whose temperature is raised over an extended period of time by surrounding electrical-resistance elements. The pebble bed and heating elements are contained in an internally insulated pressure vessel.

The use of combustion as a heat source was impractical for this installation because 24-hr monitoring would be required during idling. Indirect combustion heating of the bed would have meant additional complexity. Exothermic chemical reactions for direct heating of the bed would have required additional development. If a metallic resistance-heating element, for example, of molybdenum, coated with molybdenum disilicide to retard oxidation, were used, the life at 3460 R would be only about 100 hr, and a refractory packing or other nonoxidizing casing would have to be developed to extend its life.

The heating elements chosen were silicon carbide, of a type used in kilns and heat-treating furnaces, and are enclosed because of mechanical weakness and some contamination effect. They are manufactured in the form of straight rods by the Carborundum Company under the trade name Globar.[2] Twelve 1.7-in-diam, 60-in. effective-heating-length rods with an initial resistance of about 1 ohm are used to supply up to 75 kw if required. At temperatures around 3260 R, they can be expected to last several thousand hours and can be operated at 3500 R for shorter periods of time.

A typical value of power input per unit area of Globar radiating surface is 20 watts per sq in. when current is flowing. Electrical resistance increases with operating

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[1] Professor of Aeronautical Engineering, Polytechnic Institute of Brooklyn Aerodynamics Laboratory, Brooklyn, N. Y.

Contributed by the Aviation Division and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of The American Society of Mechanical Engineers. Condensed from Paper No. 59—A-233 which included design calculations and extensive References.

[2] Similar elements are made by the Norton Company under the name Crystolon.

*pressurized air to high temperatures without adding contaminants*

**By Martin H. Bloom,**[1]

Freeport, N. Y.

# for 3000 R, 600 psia

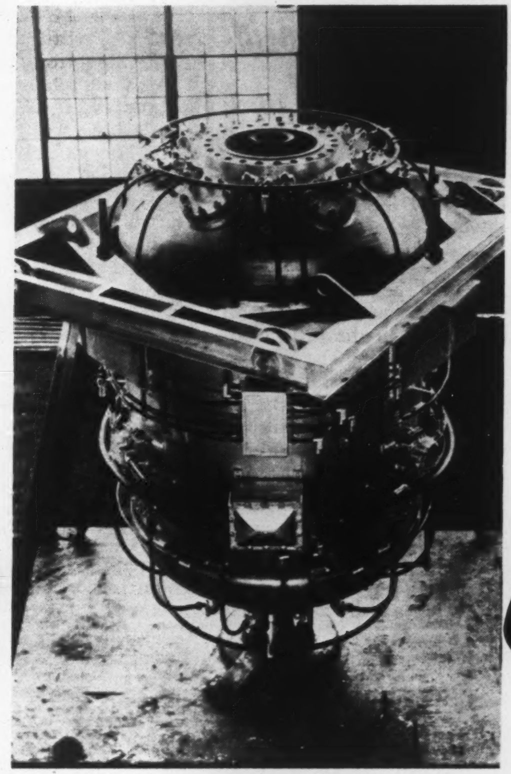

**Fig. 2** The convection heater uses electrical-resistance heating elements to build up a supply of heat over a long period in a storage bed of ceramic pebbles. When released, 10-lb-per-sec runs of 3000-R, 600-psia air are supplied for durations on the order of 1 min.

time, hence power is supplied through multiple-tap autotransformers from a 230-volt source with metallic leads clamped to the ends of the Globars.

Stabilized silicon carbide was chosen as the structural material for the storage-bed retaining liner and the exhaust conduit after consideration of a number of materials. For the most part, standard brick shapes were used. There was no overriding reason for favoring the many-holed blocks, tubes, rods, segments of rods, and the other special shapes available over a bed of simple spherical pebbles.

The largest pebbles manufactured in the quality desired were chosen. Randomly arranged spheres formed a simple and economical bed that was conveniently assembled. For heat-transfer purposes it is effective, since the storage mass and the surface area per unit volume of the bed are large and the convective-heat-transfer coefficient for this configuration is relatively high. Large quantities of heat can be stored in the compact bed and quickly transferred to the flowing gas. The pebble size was selected to give a favorable relation between heat-transmission characteristics and the static pressure losses in the bed. The value of the porosity is in the neighborhood of 0.45 to 0.48.

Insulating material backs up the silicon-carbide lining of the bed and separates the high-temperature bed from its encompassing 1210-R pressure vessel. Fused-alumina insulating material was used for the high-temperature region near the bed. For the lower-temperature region, the insulating bricks were of standard type with graded temperature ratings. A total insulation thickness of 18 in. over most of the heater maintains the pressure vessel below 800 R with radiation cooling alone. The operating power loss is not a major factor in the insulation design.

Because the Globar elements, the silicon-carbide liner, the alumina pebbles, and the high-temperature insulating materials might deteriorate under elevated-pressure conditions, and because of the cost of the containing pressure vessel, the operating pressure was limited to 600 psia; it is practical now to use higher pressures.

To dispense with a refractory retaining baffle, the pebble bed was oriented with its axis vertical and the maximum streamwise pressure gradient was kept below the specific weight of the pebble material so they would be restrained by their own weight.

The over-all cost of a heater, which varies almost as the cube of the diameter, and the fact that 2-ft-diam is a standard size for the silicon-carbide circle bricks which comprise the retaining liner, determined that dimension. Fairly large design factors can be utilized in setting the length, and an over-all bed length of 6 ft was selected.

Approximately 5 ft on the upper end of the bed is considered to be at a maximum temperature and therefore fully effective for heat-transfer purposes. About 1 ft at the bottom is considered to be a transition length which serves two main purposes—insulating the steel structure supporting the bed and minimizing the effects of thermal shock on the upper part of the bed by gradually heating the cold incoming air.

### General Configurations

The 12 Globars are arranged around the periphery of the bed at 9-in. intervals in order to insure maximum lateral uniformity of temperature in the bed in the fully heat-soaked condition. Space is provided around the Globars so that radiation is the primary heat-transfer mechanism. The Globar chambers are maintained at the required soaking temperature by an on-off temperature controller which senses the temperature in the chambers. Sufficient power is supplied to compensate for external heat losses and, simultaneously, to supply heat to the bed as fast as it can be absorbed.

The effective heating length of the Globars coincides with the upper 5 ft of the pebble bed, which is to be kept at maximum temperature. The lower portion of the bed is insulated from the heating segment of the elements to provide the transition region.

The extensions of the Globars protrude through more than 1 ft of insulation to end in the relatively cool terminal chambers whose temperature is maintained by the insulation and by external water sprays which cool the heads of the pressure vessel forming the outer walls of the terminal chambers. The Globars, which must not be restrained axially, rest on shelves in the lower terminal chamber. The terminal leads are brought out of the pressure vessel through packing fittings of the Conax type.

The insulation, bed liner, and pebbles rest on support plates at the bottom of the heater. A central grate permits air to pass up through the pebble bed.

To allow for the thermal expansion of the internal structure, part of the exhaust section is counterbalanced to relieve the part of the load which rests on the bed liner. A sliding seal between this section and the pressure closes off the terminal chamber and prevents cool air and particles of insulation from entering the exhaust flow.

The entire heater is suspended from a movable carriage by means of three spring mountings which allow for some expansion and alignment when connecting it to another system. The total weight of the heater is about 40,000 lb.

Two alternative exhausts are provided—one vertical, the other horizontal. When one is in use, the other is blocked off.

### Operation

During the heat-up period, the on-off controller is programmed to raise the temperature gradually to full operating condition over a period of about two weeks. Once the heater is raised to operating temperature it is idled in this condition and permitted to cool down only for maintenance.

When operated in conjunction with a 1.5-in-diam exhaust throat nozzle with 300 to 600-psia heater exhaust pressures (stagnation pressures for the throat) a cumulative running time between 2 and 3 min can be achieved with less than a 10 per cent drop-off in exhaust temperature (stagnation temperature at the throat).

Air is supplied to the heater from a high-pressure, dry-air supply, through a 4-in. line with 1.5-in. pressure-regulating valve from which a 2-in. relief valve is teed off. The valves are pneumatically operated. Manual control has been used satisfactorily to maintain the exhaust pressure constant within ±5 psi during the very start of a run and within ±0.5 psi during the remainder of the run if required. The exhaust pressure can also be changed gradually during a run if this is desired.

For a given series of runs either the vertical or horizontal exhaust is closed off. Before a run starts, the exhaust port to be used is kept shut to minimize the heat loss by free convection. To prepare for a run the intake valve is operated to pressurize the entire interior of the heater, including the parts outside the bed liner, at the rate of about 5 psi per sec. Pressurization proceeds until the desired exhaust pressure is reached. To start a run the appropriate exhaust valve is opened. Simultaneously the intake valve is operated to maintain the exhaust pressure constant. This pressure is sensed near the exhaust ports. To end a run the exhaust port is closed again. Succeeding runs can be made from the same pressurized condition or the heater can be depressurized gradually by means of the relief valve.

During a run the required axial pressure drop is established in the pebble bed and exhaust channel, but since there is essentially no flow in the parts outside the bed liner, the initial pressure is maintained there. Therefore a compressive load is placed on the liner. This is desirable because of the nature of the structure and material of the liner. There is some inconsequential inward leakage through joints and pores in the liner.

The heater has been operated consistently and successfully at exhaust pressures up to 600 psia and at exhaust temperatures in the entire range up to 3000 R in all pressure ranges. In all these runs an exhaust nozzle with a 1.5-in-diam throat was used. Thus, in the high-pressure range, mass-flow rates of 8.5 to 12.0 lb per sec have been achieved. A minimum running time of 15 sec was used, with some runs being extended for as long as 60 sec. A decrease in exhaust temperature was almost never noted during a run when only one was made in a day. When more than two runs at high flow rates were made during a single day, a drop of about 5 per cent in exhaust temperature was noted in the peak temperatures of separate successive runs.

Although a certain amount of contamination has been noted in supersonic tests made from the heater, this does not appear to have had an appreciable influence on the results. Extreme cleanliness has been achieved for special runs in the 2300-R range by means of graded screens of type-310 stainless steel.

In principle, the mass-flow rate and total quantity of flow capable of being delivered with the present design can be increased considerably by increasing the dimensions of the pebble bed, although some secondary changes may be required. However, it is possible that applications such as wind-tunnel operation, an "intermittent" heater of this kind, or a suitable combination of several units can be designed for applications usually considered to require a "steady" supply.

The delivered cost was about $38,000 and the electrical and other installation costs were about $10,000 additional.

# INSPECTING TAPER THREADS
## -a new technique

*For taper threads—and cylindrical threads as well—a fast and accurate device*

*for determining the over-all geometric shape of the threads*

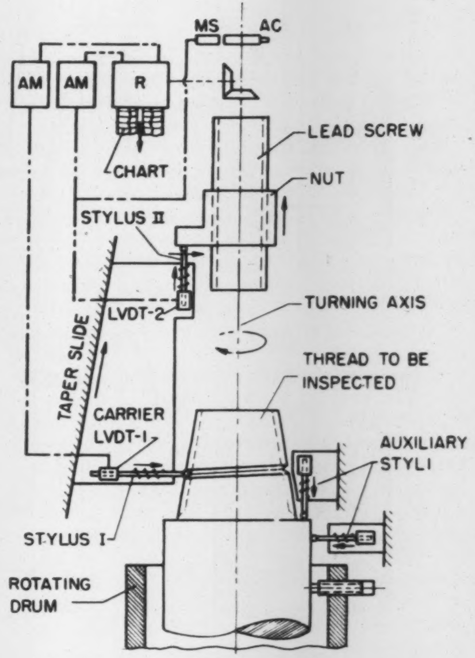

**Fig. 1** The basic scheme for obtaining recordings of external taper threads utilizes two styli. One follows the thread flanks of the thread to be inspected in the vicinity of the pitch line. The other contacts a surface of the lead-screw nut. Displacements are translated into proportional electrical output which are recorded.

**By A. A. Mittenbergs,** Mem. ASME,[1] **and Ned Rodgers**[2]

A NEW technique for inspecting taper threads was developed recently for application on the rotary-shouldered connections of tool joints used in drill pipe for oil-well drilling. This technique also can be employed for inspecting taper threads for other applications and for cylindrical threads, which can be considered as taper threads having a taper equal to zero.

The final inspection of taper threads customarily is made with plug and ring gages, whose position on the product is affected by the cumulative effect of all thread-element errors. For accurate threads and good fits, these errors must be kept to a minimum. In production, the thread profile can be controlled easily and the usual inspection instruments (such as optical comparators, thread-contour microscopes, thread-height gages, and similar devices) are generally satisfactory. Also, since threads produced with standard procedures have rather uniform profile throughout the entire thread, inspection of thread profile in a single location in most cases is sufficient. On the other hand, the existing methods for inspection of the other thread elements (lead, taper, roundness) and of the over-all geometric shape of the threads are rather cumbersome. Most of these methods measure one thread element at a time and usually in a single plane only. For determining the dimensions of the entire thread, and for obtaining a picture of the over-all thread configuration, measurements in a number of planes have to be taken.

The technique described provides a reasonably fast and accurate method for simultaneous and continuous determination of all element errors, except on profiles, and of the over-all geometric shape of the threads. The thread profiles must be inspected separately.

### Basic Principles

With the new technique, simultaneous and continuous measurements of the variations of thread pitch-cone radius and the lead are obtained against an accurate taper and an accurate lead, respectively. The variations are registered electrically and recorded on charts.

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[1] Principal Mechanical Engineer, Applied Mechanics Division Battelle Memorial Institute, Columbus, Ohio.

[2] Director of Engineering, American Iron and Machine Works Company, Subsidiary of American Machine and Foundry Company, Oklahoma City, Okla.

Contributed by the Machine Design Division and presented at the Summer-Annual Meeting, Dallas, Texas, June 5–9, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 60—SA-6.

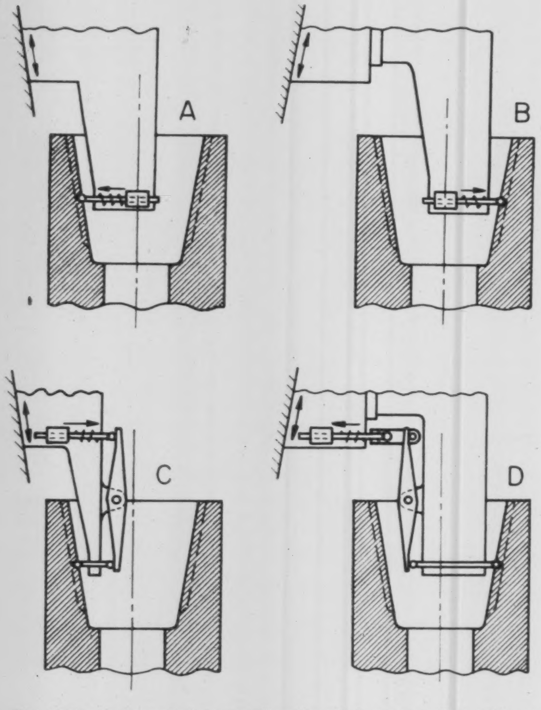

**Fig. 2** Arrangements for recording the pitch-cone radius of internal threads—**A** and **C** require the taper slide to be of opposite direction from that used for external threads, while **B** and **D** permit the same slide to be used for both external and internal threads.

Fig. 1 shows the scheme for inspecting external taper threads. The thread to be inspected is aligned concentrically within a rotating drum. The turning axis of this drum is also the axis of an accurate cylindrical lead screw having the nominal lead of the thread to be inspected. The drum and the lead screw are rotated together. A carrier, holding two axially sliding ball-point styli, I and II, is mounted on an accurate taper slide made to the nominal taper of the thread to be inspected.

The ball of stylus I engages the thread groove. The ball diameter is chosen so that the ball will contact the thread flanks in the vicinity of the pitch line. The ball of stylus II contacts a surface of the lead-screw nut. This nut is restricted from rotation, and the contact surface is made accurately perpendicular to the lead-screw axis. Both styli are spring loaded in the directions shown by arrows placed next to the spring symbols in Fig. 1. Attached to each stylus is the core of an electrical linear variable-differential transformed, LVDT. The coils of the LVDT units are mounted on the carrier with provision for adjustment. At a certain constant electrical input, an axial displacement of the LVDT core from its zero position results in an electrical output proportional to the displacement.

As the thread, together with the lead screw, is rotated, stylus I follows the thread groove and moves the carrier along the taper slide. Any variation in the horizontal distance between the taper slide and the pitch-cone radius of the thread causes a relative motion between stylus I and the carrier, and results in a change in the electrical output of LVDT-1. The vertical component of the carrier movement is controlled by the lead of the thread being inspected. Stylus II follows the lead-screw nut, which is guided by an accurate lead. Similarly, any lead variation causes a relative motion in the vertical direction between stylus II and the carrier and results

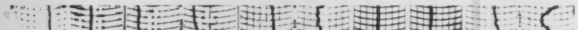

**Fig. 3** Partial recordings of taper threads with nominal dimensions of 4.532-in. pitch diameter at 0.625-in. stand-off distance; 3-in-per-ft taper; 0.200-in. lead; and with 30-deg profile half-angles. **A** is the location of the thread axis with respect to pitch-cone-radius recording; **E** the pitch-cone-radius error; **L** the lead recording—in the upward direction, a deviation of the recorded line to the left indicates positive lead error; **N** is the reference line representing the nominal pitch-cone radius; **R** the pitch-cone-radius recording; **SD** the location of the small-diameter end of the thread. Recording I is an external thread, chased, of relatively good quality, with slight localized irregularities in lead and in pitch-cone radius. Recording II is an internal thread, chased, with a positive over-all lead error larger than 0.001 in. with high (about 0.003-in.) localized lead error caused by a dent in the lead cam of the machine tool, a positive taper error larger than 0.001 in., and slight irregularities in pitch-cone radius and in lead. Recording III is an external thread, cut with a sharpened hob, with slight over-all deviations but high local irregularities within a regular pattern. Recording IV is an internal thread, cut with a dulled hob, with a positive taper deviation of about 0.001 in., and small but frequent local irregularities. Recording V is an external thread, chased, distorted during heat-treatment, with elliptical-pitch cone (maximum out-of-roundness is 0.004 in. on radius); there is positive taper deviation at the small-diameter end, a slight positive over-all lead deviation, and there are some localized irregularities in lead and in pitch-cone radius.

in a change in the electrical output of LVDT-2. The relative motion in the horizontal direction between the ball of stylus II and the nut surface has no effect on this output.

Connecting the two LVDT units through electrical amplifiers, AM in Fig. 1, with a two-channel recorder, R, provides continuous and simultaneous recordings of the two electrical outputs. These recordings are graphical representations of the deviations from nominal of the two thread elements—pitch-cone radius and lead. Data for the entire thread can be recorded on one chart. The scale of the recordings can be varied over a wide range by changing the amplification factor. Adjustments of the electrical system also permit small changes in the scales, so that a known displacement of a stylus may be represented on the chart by a predetermined distance. The latter may be accomplished by moving the stylus a known distance (for example, with a micrometer screw) and adjusting the electrical system so that the movement of the recorder pen coincides with a selected number of divisions on the chart paper.

The chart of the recorder is driven from the common turning axis of the thread and the lead screw; each revolution of the thread gives the same length of recording on the chart. To facilitate analysis, a microswitch, MS, is closed for a brief interval once every revolution by an actuator, AC, rotating with the axis. This causes a change in electrical output and results in a movement of the recorder pen, which leaves a revolution signal on the chart.

Internal threads can be inspected in the same manner as external threads. Some examples of possible arrangements of the stylus for registering the pitch-cone-radius variations are shown in Fig. 2. Arrangements A and C require the taper slide to be of opposite direction to that used for external threads. Arrangements B and D permit use of the same slide for both external and internal threads and also the same carrier if a removable attachment is provided for inspection of the internal threads.

## Thread Recordings

Fig. 3 shows portions of actual thread recordings obtained with the thread-inspection machine to be described. For a perfect thread at a perfect alignment within the rotating drum, the two recorded lines should be straight and parallel to the direction of the chart. Any departures of the recorded lines from the chart direction indicate pitch-cone-radius and lead deviations from nominal. From these recordings, if analyzed along the entire thread, the geometry of the thread can be determined. This includes taper angle, taper straightness, roundness of the pitch cone, thread-lead variations, and local irregularities of the threads. The magnitudes of the variations can be obtained directly from the recordings.

Threads should be aligned within the rotating drum as accurately as possible. Regardless of the accuracy obtained, any misalignment of threads within the drum, if present, can be readily recognized from recordings. Misalignment generally produces waves resembling sine waves with gradually changing amplitudes and period lengths approximately equal to the distance between the revolution signals. Analysis of such recordings is more complicated and, in some instances, less dependable.

**Pitch-Cone-Radius Errors.** The pitch-cone-radius recordings, by themselves, indicate the variations but not the absolute values of the pitch-cone radii or their errors. Both can be found if the process of obtaining recordings is interrupted (at any convenient time) and accurate measurements are taken of the positions of the carrier and of the stylus I, and of the distance between an accurate surface of the carrier and the thread shoulder or face surface

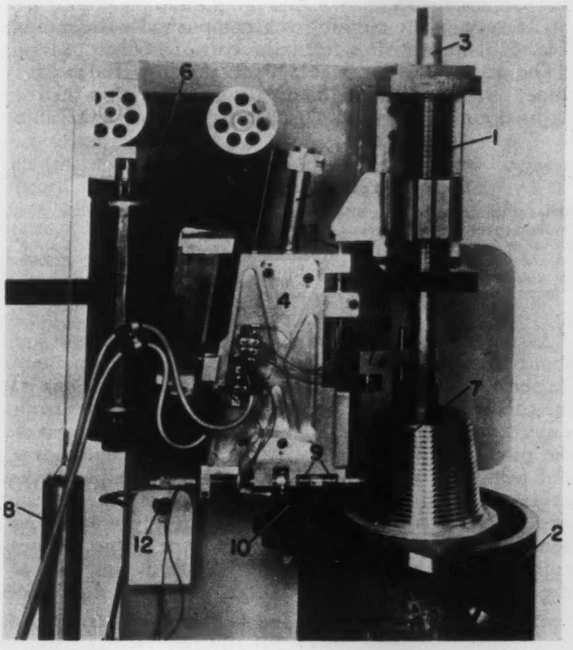

**Fig. 4** The swinging frame and carrier of the Tedar Machine in operating position for inspecting external (pin-end) threads. Since tool joints have a sufficient-diameter bore, the lead screw **1** is driven directly from the rotating drum **2** by a central drive shaft **3** inserted from above. The carrier **4** slides on a cylindrical slide **5** mounted accurately to the nominal taper of the threads to be inspected. This slide is attached to a swinging frame **6** and can be swung out of the way during loading, aligning, or inspecting the shoulder and face surfaces. To minimize the spring pressures required for keeping the ball of the stylus **7** engaged with the threads, the carrier is counterbalanced by weights **8**. The thread-following stylus is provided with two springs **9** and a sleeve **10** with a Z-shaped groove permitting the spring-pressure direction to be reversed when changing from external to internal threads. The micrometer screw **11** is used for measuring the position of the stylus (with respect to the carrier) as required for determination of pitch-cone-radius errors. To minimize the effects of pressure between the micrometer screw and the end of the stylus on the measurements obtained, an electric circuit is provided between the micrometer and the carrier. At the first contact between the micrometer and the stylus end, an electric light **12** comes on. Experience shows that the reproducibility of this system is within 0.0001 in. The other two measurements required for determination of the pitch-cone-radius errors are obtained with standard measuring devices between surfaces provided on the carrier and on the swinging frame and the shoulder and face surfaces of the tool joints. The second set of measurements required is obtained on plug and ring gages mounted in adapters. These can be inspected and measured in the same manner as the tool joints. The stylus **13** for recording the variations of lead is mounted at the top of the carrier. The shoulder and face surfaces of the tool joints are inspected with an auxiliary stylus unit **14**, which is swung out of the way when not in use

or any other axially determined locations. From this set of measurements, from a set of similar measurements obtained on a measuring fixture or on an accurate thread (for example, such as a gage thread), and from the dimensional constants of the equipment, the pitch-cone radius or its error at the measuring point can be computed easily. This enables a reference line, see Fig. 3, on the recording to be established, and from this reference line the other pitch-cone radii or their errors can be determined along the entire recording of the thread.

**Inspection of Related Surfaces.** As can be seen in Fig. 1, addition styli in combination with LVDT units can be employed to obtain recordings of shoulder or face surfaces and of any cylindrical surfaces related to the threads. These recordings should be obtained at the same alignment as the thread recordings. Obviously, only one revolution of the threaded part is required to obtain a complete recording. Such recordings of shoulder and face surfaces permit determination of the flatness of these surfaces and their squareness to the thread axis. Recordings of cylindrical surfaces permit determination of roundness and of alignment between the cylindrical surfaces and the threads.

### Application to Tool Joints

The first "Tedar Machine,"[3] constructed on the principles described, inspects both external (pin-end) and internal (box-end) taper threads of tool joints ($4^{1}/_{2}$-in-diam size, full hole). The upper portion of the machine is shown during inspection of a pin-end thread in Fig. 4.

Since the cylindrical surfaces of tool joints are generally not accurate enough to be used as reference surfaces for aligning the threads within the rotating drum, accurate aligning rings are employed. The commonly used processes for producing tool-joint threads employ "topping" cutting tools. On such threads, the distance between the thread crests and the pitch-cone radii remains rather constant throughout the threads and, therefore, the crest surfaces can be utilized for aligning purposes. The two-ring combinations shown in Fig. 5 have proved to be satisfactory. The aligning is accomplished with standard 0.0001-in-precision dial indicators.

The accuracies obtainable with the first Tedar Machine, if the tool-joint thread alignment within the rotating drum is held within 0.0001 in., are shown in Table 1.

**Table 1 Accuracies Obtainable, In.**

| | |
|---|---|
| On local thread variations and irregularities | 0.00005 |
| On lead (over the entire recording) | 0.0004 |
| On taper (over the entire recording) | 0.0004 |
| On pitch-cone-radius error | 0.0008 |
| On squareness and flatness of the shoulder and face surfaces | 0.0002 |

Accuracies obtained on the various thread elements are about 10 per cent of the permissible tolerances in these elements. The accuracy is higher for the variations of the threads, indicating how much a thread departs from a uniform geometric shape (roundness and straightness of the pitch cone, local irregularities in pitch-cone radius and lead, and so forth). The effects of possible flank-angle errors on the recordings are small for the thread size investigated. It can be shown that, for a $^{1}/_{2}$-deg flank-angle error on each flank, the error of pitch-cone-radius recording does not exceed 0.00016 in. and that of the lead recording is below 0.00009 in. Since the flank-angle errors are generally rather uniform throughout the thread, these errors have little effect on the shape of the recordings. They would introduce small errors only in the measurements for determination of the pitch-cone-radius error.

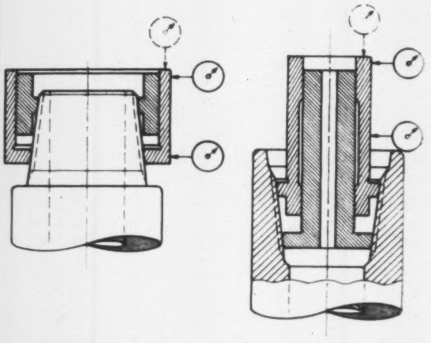

**Fig. 5** Accurate aligning rings are employed as reference surfaces for aligning threads within the rotating drum. Since the distance between the thread crests and the pitch-cone radii remains relatively constant, the crests can be used for aligning purposes. The two-ring combinations have proved satisfactory. Standard 0.0001-in-precision dial indicators are used.

### Conclusions

The new technique provides a reasonably fast and accurate method for the inspection of taper (and cylindrical) threads. Its peculiarity of registering the pitch-cone radii rather than the pitch-cone diameters measured by the usual methods describes the geometry of the entire thread more precisely. On an actual thread, two pitch-cone radii at the same axial location can be different from each other because of thread irregularities.

In thread production, the determination of the pitch-cone-radius errors from measurements obtained on the Tedar Machine may not be required. The thread recordings provide complete information of the over-all geometry of the threads. If the geometric errors and the profile errors of the threads are small, gaging and inspecting the pitch diameter with standard plug and ring gages may be entirely satisfactory. Since threads produced by the same machine tool with the same cutter and the same setting are rather alike, it may be sufficient to obtain recordings of one or two threads at the beginning of the production run. Anything wrong with the machine tools or with their adjustments and settings would show up on the recordings, permitting corrective measures to be undertaken.

Based on the principles presented, various designs and sizes of thread-inspection machines can be developed to suit particular needs. Depending on the requirements, size of threads, or other conditions, higher accuracies can be obtained than those mentioned for the first Tedar Machine. In principle, high-precision machines could also be constructed for conclusive inspection of plug and ring gages.

### Acknowledgments

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[3] Abbreviation of "Thread-Error Detecting and Recording Machine."

# A Review of HEAT TRANSFER Literature 1959

By E. R. G. Eckert,[1] Mem. ASME, J. P. Hartnett,[1] Mem. ASME,
T. F. Irvine, Jr.,[2] and E. M. Sparrow,[1] Assoc. Mem. ASME

*"Explosive' has been the word for past progress in heat transfer. Now we are back to normal research the steady advance. Here is a guide to the year's significant books and papers*

A REVIEW of the literature in the field of heat transfer published during 1959 leaves the reader with the impression that the explosive progress in certain areas which had occurred in previous years as a response to new engineering developments has been replaced by a normal research effort more equally distributed over the different modes of heat transfer. The results have been reported at conferences devoted entirely to heat transfer, like the National Heat Transfer Conference at Storrs, Conn., in August, 1959, or at special sessions of meetings dealing with related fields, see Table 1. The heat-transfer papers presented at the First International Congress of the Aeronautical Sciences held at Madrid in September, 1958, for instance, are available in book form under the title "Vistas in Astronautics." An important step in the consolidation of heat transfer as a distinctive field of physical sciences has been taken with the appearance of a new *Journal of Heat Transfer*, published by The American Society of Mechanical Engineers.

A number of well-established textbooks have been published in new editions, and much stimulation can be obtained from Russian textbooks which are now more easily available, Table 1.

The selection of specific research topics has been influenced largely by the needs of a modern and advanced technology, especially in the area of space flight. Heat transfer in gases at low densities has found increased attention and, as a consequence, these papers have been discussed in a special section. The re-entry problem of space vehicles kept the interest in the mass-transfer cooling methods awake and melting and subliming systems have been studied as well as the influence of finite chemical reaction rates within the hot boundary layers surrounding the re-entering vehicles. The absence of gravitational forces in space flight created experimental studies on gravity-free boiling and condensation, as well as an analysis of condensation on rotating surfaces proposed to avoid the difficulties with conventional systems. The high temperatures encountered made investigations on the radiation properties of gases at high temperatures and on radiative heat exchange in transparent media imperative and the extremely low temperatures under which other components operate opened a new area for research. It is remarkable that heat transfer could be investigated experimentally in channel flow at average wall temperatures as high as 4500 F. The interest in noncircular ducts as an element for heat exchangers is still very strong.

Comparatively few papers presented new exact boundary-layer solutions. The interest has obviously shifted to a consideration of chemical reactions as well as of magnetic or electric fields on boundary-layer heat transfer. Such studies have also been extended to free-convection flow. Generally, free convection as well as combined free and forced convection have found considerable attention, probably in response to new design trends in nuclear power plants.

Unsteady heat transfer and the thermal-radiation processes in the atmosphere are treated in a number of papers.

From a mathematical viewpoint, recent analyses are characterized by the fact that they deal often with strong nonlinearities either in the defining equations or in the boundary conditions.

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[1] Heat Transfer Laboratory, University of Minnesota, Minneapolis, Minn.

[2] Professor, Mechanical Engineering Department, North Carolina State College, Raleigh, N. C.

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# HEAT TRANSFER

## Conduction

Several investigations of analytical techniques for the solution of unsteady-state heat-conduction problems may be looked upon, in a broader sense, as contributions to the area of boundary-value problems of mathematical physics. In one of these papers [1A] Lagrangian methods are utilized and the temperature is replaced by the heat content as the dependent variable. The approach is illustrated by obtaining a solution to the heating of a composite slab with convective and variable-temperature boundary conditions. Companion papers [19A, 20A] involve a mathematical reformulation of the heat-conduction problem, thus allowing a wider class of functions than usual to satisfy the equations.

Extended surfaces, or fins, continue to be of interest. Simple fin-design procedures with particular application to the problem of cooling semiconductor devices are given in [5A]. Computer solutions for the two-dimensional flow of heat in annular fins [10A] allow the specification of the error involved when one-dimensional solutions are used. A particularly interesting contribution [6A] presents a rigorous proof of E. Schmidt's proposal that the fin of optimum shape is the one with a linear temperature variation from the root to the tip, and also investigates the loss of fin performance if the shape varies slightly from the optimum.

Cylindrical geometries under various conditions have been further investigated, such as the steady-state temperature distribution in a hollow *n*-layered circular cylinder [24A] where the boundary temperatures vary in both the tangential and longitudinal direction. For a single-layer hollow cylinder, the steady-state temperature field has been calculated when both the thermal conductivity and volume heat source are temperature-dependent [13A]. Error criteria are given to evaluate the approximation involved when constant-property and constant-heat-source solutions are used. An unsteady-state solution [16A] for an infinite cylinder, the surface of which is subject to a thermal flux which decreases linearly with time, permits the calculation of temperatures reached in linings and drums of brakes under uniform deceleration. An extension of this study [17A] has been made for composite slabs under the same boundary conditions. The time-temperature history of an infinite-solid cylinder has been determined when heat is transferred to it in a manner resembling high-speed flight [4A]. The cylinder axis is normal to the direction of flight and the cylinder is rotating about this axis.

Additional studies have appeared on transient heat-conduction problems involving melting or freezing. Previous solutions are briefly reviewed in [15A] and two numerical methods are presented. An exact solution is given [8A] where the rate of movement of the boundary is inversely proportional to the square root of the time and the original temperature of the region is constant.

The convergence of relaxation solutions in unsteady-state conduction is discussed from a physical viewpoint in [21A]. Convergence criteria are related to the theorem of Prigogine on the minimum production of entropy. A comprehensive investigation of the effective thermal conductivity of powders has been reported [12A]. The experimental results in the temperature range from 100 to 1000 C can be explained by assuming that the effective conductivity is composed of a gas solid conductivity and an equivalent radiation conductivity.

Several investigations relating to specific technical applications have appeared. A digital-computer solution [3A] of the transient temperature distribution in a porous solid has been utilized in the design of matrix-type rotary gas-turbine regenerators. An unsteady-state solution [26A] has been applied to determine the temperature distributions and thermal stresses which occur in the carbonization of briquets.

A number of extensions or improvements of classical transient-conduction solutions have appeared: Composite infinite slabs [23A]; two-component, semi-infinite slabs subject to aerodynamic heating at one boundary [22A]; elliptical cylinders of varying eccentricities [11A]; cylinders, spheres, and cubes under a variety of boundary conditions of technical importance [9A]; and approximate three-dimensional solutions in shells of revolution [2A].

Unsteady conduction problems for which the boundary heat fluxes depend in a nonlinear way on the boundary temperatures are mathematically investigated in [7A]. Another study [25A] investigates the unsteady temperature field in a wall which is adjacent to a well-stirred fluid with a finite heat capacity where one side of the wall is at constant temperature and there is a convective exchange of heat with the fluid on the other side.

Charts are presented [14A] for determining the temperature at a point in a semi-infinite solid when the surface temperature or heat flux varies in an arbitrary manner with time. The solution to the inverse problem is also outlined.

A method of experimentally determining three-dimensional transient heat flows in solids [18A] utilizes a continuous resistance medium but has discrete capacitances.

## Channel Flow

In recent studies of steady heat transfer in circular tubes, primary consideration has been given to turbulent flows. In the theory of the thermal entrance region, continued use has been made of the eigenvalue-eigenfunction approach. Two problems, one dealing with variable wall temperature [18B] and the other with internal heat generation [11B], have been analyzed in a formal manner, but without numerical results. An approximate procedure for calculating higher eigenvalues and eigenfunctions has been proposed [2B]. Measurements have been made of heat transfer and friction for helium (gas) flowing in an electrically heated tube with average wall temperatures ranging up to 4533 R [27B]. In the turbulent regime, local Nusselt numbers were correlated using fluid properties evaluated at the film temperature, while average Nusselt numbers were correlated using properties evaluated at the surface temperature. Using new experimental results for viscous liquids (some of which fell below Reynolds number 10,000) in conjunction with older data, a new correlation for turbulent heat transfer in tubes has been proposed [7B] for the Prandtl-number range from 0.5 to 600. A study of recovery factors in tubes directed primarily at turbulent flows has been carried out experimentally and analytically [5B]. In subsonic flow measurements with air extending to a Reynolds number of 650,000, the recovery factor was found to lie between 0.85 and 0.9. The effect of variable properties was investigated experimentally in oils [17B], and a correlation including the tube length-diameter ratio as well as property effects is given.

Considerable attention has been directed to steady heat transfer in noncircular ducts. The calculus of variations has been used to compute fully developed laminar heat transfer [25B] for various examples of rectangular and circular-sector cross section. A strong effect of the circumferential thermal boundary conditions on heat-transfer performance is shown. New solutions for fully developed laminar heat transfer use the classical method of trigonometric series [9B]; one of the interesting cases considered was the flow between heated parallel plates separated by unheated ribs. In a fundamental study [14B], the conditions and limitations under which fully developed laminar flow in a parallel-plate channel is possible are discussed, including those associated with heat transfer. An analysis has been made of the effect of an arbitrary temperature-viscosity relation on the Couette flow of a laminar, heat-dissipating liquid [19B]. The problem of the simultaneous development of the laminar velocity and temperature distributions in a parallel-plate channel has been treated in two papers—consideration is given to compressible gas flow under conditions of a uniform wall temperature or an adiabatic wall in [24B]; while in [22B], solutions are given for the uniform-heat-flux boundary condition for Prandtl numbers from 0.01 to 50. Turbulent heat transfer in noncircular ducts has been analyzed for passages of equilateral-triangular and square cross section [4B] by applying universal velocity and temperature profiles which had been previously used in circular-tube analysis. For the parallel-plate channel, the fully developed heat-transfer condition has been solved for two boundary conditions [1B], for a Prandtl number of 7, and a turbulent Prandtl number of 0.7.

Experimental studies of heat transfer in noncircular ducts has also been carried out. Turbulent-heat-transfer coefficients for water flowing in a flat electrically heated rectangular duct (aspect ratio 25) have been reported [13B]. The Nusselt numbers for nonboiling conditions fell from 30 to 45 per cent below the Sieder-Tate equation. The effect of discrete roughness protrusions on friction and heat transfer in a rectangular duct having small dimensions (equivalent diameter = 0.035 in., aspect ratio $\sim$ 5) has been investigated experimentally [12B]. Measurements of the temperature and velocity field [6B] for a specific duct geometry which bends the flow by 90 deg and accelerates it to twice its initial average velocity demonstrated considerable rearrangement of the temperature field due to the secondary flow.

Problems involving unsteady heat transfer in passages have also been investigated. For a fully developed, steady laminar flow, analysis has been made of the transient thermal response in the thermal entrance region of a circular tube [26B] or a parallel plate channel [23B]. The basic solutions for step-changes in wall temperature or wall heat flux are generalized to apply to arbitrary time-variations by a superposition integral. The transient thermal response for a slug flow for these two geometries and boundary conditions has also been found [21B]. An empirical method has been devised [16B] for correlating the effects on heat transfer of a resonating sound field superposed on turbulent gas flow in tubes. Heat transfer to liquids in intermittent flow is also discussed [3B].

In the rapidly developing area of magnetohydrodynamics, two papers [20B, 8B] have appeared relating to channel flow.

The analogy between turbulent heat and momentum transfer is extended to include non-Newtonian fluid systems [15B]. The theory is compared to experiments on turbulent flow of slurries and polymer solutions and an average deviation of 17.6 per cent is found.

In a study of the vortex tube [10B], measurements were made of the velocity, temperature, and pressure distributions in a 3-in-diam circular tube. An explanation of the phenomena is advanced and the effects of secondary flow and turbulence are discussed.

# Boundary Layer Flow

**Boundary-Layer Solutions.** Several contributions have been made on fundamental problems in steady-state laminar-boundary-layer heat transfer. In a study of the effect of a nonisothermal free stream on the heat transfer from a flat plate [43C], low-Prandtl-number fluids are shown to be affected much more by nonuniformities in free-stream temperature than high-Prandtl-number fluids. A set of exact solutions for low-Prandtl-number boundary-layer flow over a flat plate with uniform wall temperature or uniform wall heat flux has been tabulated [44C]; and corresponding temperature profiles presented. In the compressible laminar boundary layer at the stagnation line of a yawed cylinder [31C], heat transfer was found to decrease with increasing yaw angle, but in a manner which depends strongly on the Mach number. In further study of incompressible-boundary-layer flows with free-stream-velocity and wall-temperature distributions expressed as sums of powers of the distance from the leading edge or stagnation point, a formally exact solution in the form of a series has been constructed by Frössling [15C]. The extension of Görtler's series method to this problem has received additional attention [19C, 49C]. For heat transfer in longitudinal flow along a circular cylinder, a Karman-Pohlhausen-type analysis has been made [6C] to bridge the gap between previous solutions near the leading edge and far downstream.

For unsteady laminar-boundary-layer heat transfer, an exact solution has been reported for the heat-transfer response at the stagnation point to a free-stream velocity which varies inversely as a linear function of time (sic). Using parameters from this solution, an approximate calculation method is proposed for arbitrary time-variations in free-stream velocity [51C] and arbitrary surface configuration [50C]. An analysis has also been made for unsteady stagnation-point heat transfer [42C] when the wall temperature varies and the flow is steady.

Calculation procedures motivated by applications to high-speed flows with streamwise pressure gradients have been devised for finding the heat transfer to both laminar [3C] and turbulent [10C] boundary layers. An approximate method for computing supersonic laminar heat transfer on a cone at large angle of attack has also been proposed [7C].

Two problems having to do with shock-boundary-layer interaction have been studied analytically—one dealing with the interaction of a normal shock with a thermal boundary layer [1C], the other with the problem of the shock-induced, unsteady, compressible boundary layer on a flat plate [28C].

**Dissociation and Chemical Reactions.** Boundary layers on the surface of re-entering missiles or satellites are heated to such an extent by internal friction that the air is partially dissociated or even ionized to a degree depending more or less on the catalytic efficiency of the surface. Recent analytical studies determined heat transfer in the neighborhood of the stagnation point of a blunt body and its dependence on the catalytic efficiency of the surface [18C, 35C, 39C]. A very elementary calculation results in a good relation for heat transfer with dissociation and for various catalytic efficiencies [34C]. Measurements of heat transfer near the stagnation point in hypersonic flow of a partially ionized gas [37C] were made in a shock tube with argon. It is assumed that underestimation of the heat-transfer coefficient in an ionized gas in available analytical results is caused by lack of knowledge of the transport properties. Laminar-heat-transfer coefficients around blunt bodies of arbitrary shape can be calculated by approximate methods [14C, 27C, 46C]. Measurements on slender objects simulating flight speeds to 20,000 fps and Reynolds numbers of 25 $\times 10^6$ verified the constant-property relations for a turbulent boundary layer used together with the reference-enthalpy method [36C]. Integral momentum and energy equations were used to estimate turbulent heat transfer at the sonic point of a blunt-nosed body [41C].

**Magnetohydrodynamics.** The determination of flow and heat transfer of an electrically conducting fluid under the influence of a magnetic field has found considerable attention. All of the papers are of an analytical nature because of the great difficulties connected with experimental investigations. Existing magnetohydrodynamic boundary-layer solutions were summarized and evaluated [20C] and brought into a form which shows the analogy to flow under the influence of gravitational and centrifugal forces. A magnetic field changes the flow in the neighborhood of a stagnation point mainly in the inviscid region outside the boundary layer [29C, 30C]. An estimate for a flat-plate boundary layer of air at a flight Mach number 25 indicates that it is not practicable to reduce heat transfer by a magnetic field unless the electric conductivity of the air can be artificially increased. Specific flow situations studied on a flat plate comprise: An oscillating infinite plate [25C], an infinite plate suddenly set in motion [36C], and a steady boundary layer on flat plate [36C]. The last study includes the situation where the electric conductivity of the fluid varies throughout the boundary layer. An analysis of hypersonic Couette flow for Mach 10 to 30 indicates that a weak magnetic field can produce large increases in total drag; large reductions in skin friction, however, have little effect on heat transfer [4C]. A study of the flow of an electrically conducting fluid through a rectangular duct considers finite and infinite conductivity of the duct walls [9C]. Particular solutions of magnetohydrodynamic flow can be superposed under certain conditions [26C]. Two Russian papers [16C, 17C] analyze two-dimensional problems in magnetohydrodynamics and study the influence of a finite conductivity.

**Experimental Investigations.** The interest in blunt shapes for missiles and satellites caused a number of experimental investigations in which heat transfer has been measured [5C, 11C]. The arc-heated plasma jet has become a useful tool to measure heat transfer to objects for very high stagnation enthalpies (8800 Btu per lb) and stagnation temperatures (12,000 F) [21C]. Measured heat-transfer coefficients near the stagnation point of a blunt object agree well with theory. The influence of an angle of attack has been studied [38C, 52C] on a blunt-nosed cone, a cone-cylinder, and a parabolic-nosed cylinder. Heat transfer on the cone was found to agree within 30 per cent with analytical predictions on the windward generatrix. On the cylindrical part, the heat transfer was from two to three times larger on the leeward side than on the windward side at an angle of 3 deg, and $^1/_2$ the value on the windward side at an angle of 18 deg. In a study on boundary-layer transition [2C], local temperature-recovery factors have been reported on hemispheres with various surface roughnesses at Mach 2.5 to 3.5.

Measurements on turbulent boundary layers, covering the surface of slender bodies in free flight or in a shock tube, verified generally the validity of constant-property relations when the heat-transfer coefficients were based on enthalpies [24C, 40C]. A group of experiments studied the influence of a local variation of the surface temperature on heat transfer. Stepwise changes in the wall temperature [12C, 13C, 22C, 32C] and arbitrary changes [32C] have been considered. For a stepwise change, the experiments generally gave heat-transfer coefficients between the values predicted by Seban and Rubesin. The spread of the temperature boundary layer into the flow boundary layer for a stepwise change in wall temperature was investigated in detail [22C]. Free-stream turbulence [45C] as well as local roughnesses [8C, 48C] generally increase heat transfer.

# Flow With Separated Regions

Analytical methods have recently been developed by which local or average heat transfer can be predicted in laminar separated flow. The model for such a calculation [2D] separates the flow into a recirculation region separated by a streamline from the outward flow. Integrated momentum and energy equations are solved with assumed reasonable shapes for the velocity and temperature profiles. Turbulent-heat-transfer rates have been measured on the blunt base of a hemisphere-cylinder in a shock tube at shock Mach numbers between 3.25 and 5.1 [5D]. Measured heat-transfer coefficients at the center of the base were approximately equal to those on the cylinder surface just ahead of the base. Toward the rim, the base heat-transfer coefficients decreased to $^{1}/_{2}$–$^{1}/_{3}$ of the value at the center which is explainable by the recirculation of the fluid in the separated region. Pressure drop and heat transfer have also been measured for turbulent flow through a tube with different turbulence promoters (orifices, disks, propeller-shaped baffles, helically twisted metal sheets, and different packing materials) at Reynolds numbers from 500 to 80,000 [3D]. The results presented as friction factors and Stanton numbers are very similar to the results obtained in rough tubes by Nunner. Extensive heat-transfer and friction measurements for air flow through finned and unfinned tube banks have been reported at Reynolds numbers from 2000 to 35,000 [6D], at tube-wall temperatures from 600 to 1400 F, and at 530 F air-inlet temperature. The heat-transfer results for the unfinned tubes agreed well with measurements at small temperature differences when the properties in the dimensionless parameters were evaluated at film temperature. The density in the friction coefficient had to be evaluated at bulk temperature. Heat-transfer measurements from a single cylinder at Mach numbers 0.05 to 0.8, Reynolds numbers 1 to 75, and Knudsen numbers 0.009 to 0.77 [1D] are mainly applicable to hot-wire anemometry. Heat transfer in unsteady free convection was studied on a horizontal platinum wire with 0.05-mm diam immersed in various liquids and heated by an alternating current [4D]. Local-heat-transfer coefficients along the radius of a circular disk subjected to an air jet impinging in an axial direction have been measured [7D].

Heat and mass transfer from the wall to a fluid in a packed bed were measured separately [9D]. Colburn *J*-factors describing heat and mass transfer at the wall agreed closely. Heat transfer between a fluidized bed and a horizontal tube can be presented by two relations, one for fine particles and a second for heavy particles. Both correlate the test data within 40 per cent [8D].

# Transfer Mechanism

**Transition to Turbulence.** Research on the detailed nature of transition to turbulence promises better understanding in the near future and should be very fruitful in heat-transfer research. The idea that turbulence appears at first in local bursts, introduced by H. Emmons, has found verification in schlieren photos of slender bodies in free flight with supersonic velocities [7E], Fig. 1. Similar National Bureau of Standards studies [9E] demonstrated that the instability waves which often start the transition process concentrate their energy unequally in spanwise direction as they increase in amplitude. In this way they introduce a three-dimensional feature into the flow and it is assumed that the turbulent spots develop from the areas of concentrated energy. The tend-

**Fig. 1a** Turbulent bursts on a slender ogive cylinder in free flight at a Mach number of 3.6 and unit Reynolds number of 3.6 million per in. (Ref. 7E).

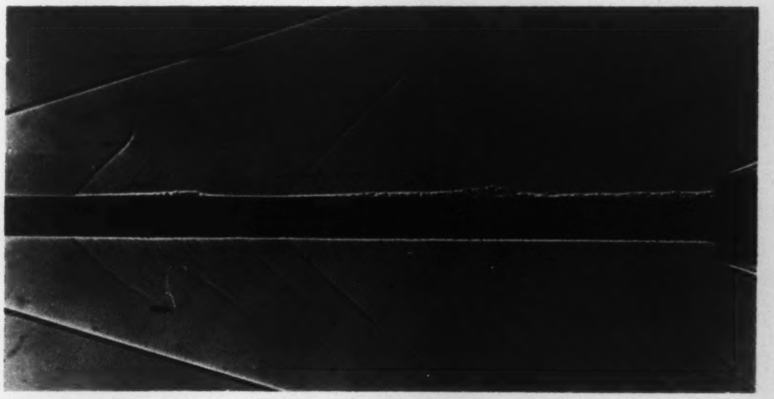
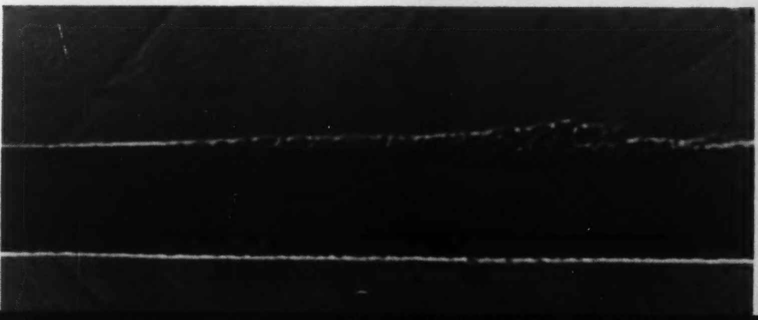


**Fig. 1b** Enlarged view of a turbulent burst



# HEAT TRANSFER

ency toward a three-dimensional vortex flow pattern is also demonstrated in the shear layers close to the wall within a turbulent boundary layer [10E].

Transition of the instability waves to three-dimensional flow has been studied analytically with considerable success by H. Görtler and his associates [5E]. The work was also extended [17E] and applied to low-density flow [8E]. Instability currents in a conducting fluid layer heated from below can be suppressed by an electric current in some instances; whereas for other modes, the electric field has no effect [18E]. Independent experimental investigations [4E, 14E] on the influence of isolated three-dimensional roughness on transition to turbulence determined that transition depends primarily on a critical Reynolds number which is based on roughness height and velocity plus viscosity at the top of the roughness element.

**Established Turbulence.** Reynolds equations describing turbulent flow have the basic disadvantage that they contain more unknowns than equations. Broszko proposed, in 1951, to introduce the necessary number of auxiliary equations from a study of the averaging process which led to the turbulent-boundary-layer equations. W. Squire [15E] finds that some basic assumptions in Reynolds equations break down for certain flow regions and finds it necessary to subdivide the whole flow field into a turbulent core and a laminar sublayer. After a scrutiny of the boundary conditions necessary to match both flow regions, he proposes a procedure for solutions to specific problems. A simple equation for the Stanton number describing heat transfer in turbulent flow of fluids with high Prandtl numbers [11E] was derived from Reynolds analogy.

The eddy diffusivity in turbulent flow through an annulus exhibits two peaks on both sides of the radius of maximum velocity [2E]. The ratio of eddy diffusivity for heat and momentum appears to vary considerably throughout the boundary layer for turbulent free-convection flow. A calculation from correlated measured profiles indicates a variation from 0 to 5.5 in the inner half of the boundary layer [3E]. Ultrasonic sound waves of 400 kc increase the heat-transfer coefficients for flow of heated oil over a porcelain surface up to 20 per cent. The increase was less for flow of water and undetectable for flow of air [13E].

**Energy Separation in Vortex Flow.** A classical paper by Ackeret which explains the low temperature-recovery factors found by E. R. G. Eckert and W. Weise at the downstream side of cylinders in a transverse high-speed subsonic flow has been translated [1E]. Ackeret demonstrated that the periodic vortex shedding is responsible for the described effect. Strong energy separation in supersonic flow can be obtained by a resonance tube placed into the flow field with its open end in the upstream direction. Spark photos of the interior of the tube exhibit shocks moving back and forth and it is assumed that these shocks are responsible for the energy separation [6E]. Calculated circumferential-velocity profiles in a turbulent vortex flow [12E] indicate that the profile shape changes strongly with a Reynolds number based on the radial flow velocity at the outer vortex radius and on the turbulent diffusivity in addition to the kinematic viscosity. The temperature separation in such a flow was studied in a Russian publication [16E].

## Natural Convection

In the study of steady, natural-convection heat transfer, considerable activity continues to be directed toward vertical and horizontal plates and cylinders. Both analytical and experimental investigations have been made for vertical cylinders of small diameter [10F]. Data from the experiments taken on a $^1/_4$-in. rod and a 0.01-in. wire were in good agreement with the predictions of a Karman-Pohlhausen-type analysis. The effect of a heat source in the boundary layer of a vertical plate or a horizontal cylinder has also been analyzed by the Karman-Pohlhausen method [21F]. For a given temperature difference, the heat-transfer coefficient is increased when the heat source is present. A set of exact boundary-layer solutions for the isothermal vertical plate has been carried out and tabulated [28F] for the low-Prandtl-number range ($0.003 \leq \mathrm{Pr} \leq 0.03$). Over this span, the local Nusselt-number results could be closely represented by

$$\mathrm{Nu} = 0.565\,(\mathrm{Gr}\,\mathrm{Pr}^2)^{1/4}$$

Japanese investigations [4F, 5F, 12F, 31F] on several topics in the theory of the vertical flat plate include variable wall temperature and variable fluid properties. Certain aspects of this work have already appeared in the literature. Natural convection from horizontal plates has been studied both for the case of uniform surface temperature [29F] and uniform surface heat flux [16F]. Consideration has also been given to natural convection which is due to differences in composition rather than differences in temperature [14F]. Velocity distributions were measured by optical means by observing the motion of suspended particles. A Karman-Pohlhausen analysis was used to provide velocity expressions in which certain unknown constants were evaluated from the experimental data.

Interest in combined forced and free-convection flow and heat transfer has continued. A study of the similar boundary-layer solutions for such combined flows [26F] found that similar solutions are possible when the free-stream velocity and surface temperature vary, respectively, as $x^m$ and $x^{2m-1}$. Numerical solutions were found for gases, and from these, criteria were derived for purely forced, purely free, and mixed flows. The problem of combined forced and free convection on an isothermal vertical plate with a uniform free-stream flow, which does not yield a similar solution, has been analyzed both by a Karman-Pohlhausen technique [1F] and a series-expansion method [27F]. A flow-separation phenomenon may occur when the free convection opposes the forced flow [1F, 26F]. An analysis has been made of the effect of buoyancy forces on both steady and unsteady velocity distributions in the fluid adjacent to an infinite plane surface with suction [9F]. Aside from boundary-layer studies, there has also been interest in combined forced and free convection in vertical tubes. An analysis made for fully developed laminar flow and heat transfer corresponding to the case of uniform wall heat flux [11F, 2F] duplicates existing work.

Visual study of both aiding and opposing flows, with water as working fluid, has provided insight into flow reversals and instabilities [11F]. Empirical formulas, based on measurements, are given [19F] for calculating the heat transfer where the free and forced convection are opposing. Acoustic vibrations have been shown experimentally to have little effect on the heat-transfer coefficient for combined forced and free-convection flow in a vertical tube with uniform wall temperature [15F] below a threshold sound level of 118 db; above 118 db, the sound appeared to destroy the free convection and became an important factor.

The stability of fluid layers which are hotter (and less dense) below continues to attract attention. An experimental study [25F] to determine whether the criterion for instability of such layers would be affected by the rate at which heat was added from below found that, for mercury and silicone oil in thin horizontal layers having circular planforms (8-in-diam), the critical Rayleigh number for instability was 1700. Additional analytical work was done on the stability problem associated with the free-convection flow in vertical tubes or channels when a negative temperature gradient is maintained in the upward direction [32F]. Russian articles relating to the stability problem have also appeared [23F, 7F]. Taylor instability is somewhat different. It considers the instability of a small disturbance imposed on the interface separating two infinitely extended fluids when the system is undergoing a constant acceleration directed from the lighter to the heavier fluid. The initial conditions which can be used in a linearized treatment of the problem have been defined [3F]. The generation of a vortex street in a free-convection boundary layer has recently been discussed [6F].

There has been both analytical and experimental work on free convection in enclosed spaces. In experiments using mercury and water in a vertical cylindrical tube with uniform-wall heat flux, closed at the bottom and connected at the top to a large cooled reservoir [13F], the system was inherently quasisteady with the highest values of the time-averaged wall temperature at the bottom of the tube. Heat-transfer results for horizontal cylindrical liquid layers heated from below have also been obtained experimentally [8F]. A numerical method based on trigonometric series has been developed for laminar free convection in horizontal, oblique, and vertical gas layers [20F]. Free convection in a saturated porous medium has been studied [30F] using sand and water confined between coaxial vertical cylinders having different temperatures.

In the area of unsteady heat transfer, the temperature response of a fine platinum wire cooled by free convection and heated by an alternating current [18F] has been measured. In an analysis of the transient free convection in the fluid contained between concentric spheres [22F] the fluid is initially at rest and has a uniform temperature different from the bounding surfaces.

Hydromagnetic effects in free convection have been studied in an inclined, closed, cylindrical tube filled with mercury [24F]. The direction of the uniform magnetic field was always normal to the tube axis, but there was freedom to apply the field at different circumferential positions. It was found that the presence of the magnetic field decreased the heat transfer. A thermoelectric convection is described [17F] in which colder air is sucked into the electric field surrounding a hot electrified filament.

## Convection from Rotating Surfaces

Heat transfer from a single rotating disk including the influence of a nonisothermal surface temperature has received attention. Noting that Reynolds analogy between skin friction and heat transfer should be valid for this geometry, experimental measurement of the torque is used to advance a prediction for turbulent heat transfer on an isothermal disk. In addition, an integral method is used to obtain approximate solutions for an arbitrary wall-temperature distribution for both laminar and turbulent flow under the assumption that the Prandtl number is unity [4G]. For turbulent flow, this same problem of a nonisothermal surface on a rotating disk received approximate treatment in [3G]. The results of experimental mass-transfer measurements with a single naphthalene disk rotating in still air are applicable by analogy to heat transfer. Agreement within 5 per cent of the predicted performance was found in the laminar regime, but turbulent results were somewhat lower than predicted by the heat-transfer-momentum analogy [6G]. New laminar-boundary-layer solutions for heat transfer from a rotating disk cover the Prandtl-number range from 0.01 to 100; asymptotic expressions are given for fluids of very high or very low Prandtl numbers [8G].

A mathematical treatment of the unsteady flow field and heat transfer in the region between two parallel infinite porous disks, revolving at different velocities which may be time-dependent, has been advanced; time-varying influx into the central region through the porous disk surfaces is also taken into account [9G].

The torque required to rotate a single disk completely enclosed in a casing and with the sides of the casing open has been investigated [2G] and should be of value in estimating the heat transfer in such flow situations.

Heat transfer from a horizontal cylinder rotating in oil with Prandtl numbers ranging from 130 to 660 has been reported allowing a comparison with existing data for air [7G]. The results include free convection with the cylinder stationary and it is reported that the influence of rotation on this free-convection performance is a function of both the Reynolds and Prandtl numbers. For turbulent flow the momentum analogy does not yield a good prediction for oil; however, a satisfactory correlation is achieved using a representation advanced earlier by Eisenberg for extremely high Prandtl-number fluids [7G].

Experimental heat-transfer data are reported for concentric rotating cylinders with enclosed air as the working fluid. At low rotational velocities the heat transfer is primarily due to conduction, but at higher velocities, vortex flow occurs and increases the heat transfer; an analogy solution for this system is also included and is in fair agreement with experiment [1G].

The influence of spin on free convection to thin mercury layers is to reduce the heat transfer whenever a certain critical value of the rotation is exceeded. This critical Taylor number (dimensionless rotation parameter) is found to increase with increasing dimensionless heat flux [5G].

## Combined Heat and Mass Transfer

The laminar-boundary-layer solutions of Brown and Donoughe for the injection of air into a laminar boundary layer on a wedge-shaped body with an Euler number of $^{1}/_{3}$ and Prandtl number of 0.7 have been extended to cover a wide range of wall-to-free-stream temperature ratios and transpiration rates. These solutions are applicable to the stagnation region of axisymmetrical bodies by means of the Mangler transformation [17H]. Solutions for transpiration-cooled cones, with constant-property adiabatic wall for two different distributions of the injection velocity (i.e., $x$ or $1/\sqrt{x}$), are restricted to unity Prandtl number and also include the case of suction [11H].

That lighter gases are much more effective than air as mass-transfer coolants is demonstrated in laminar-boundary-layer solutions for the injection of helium [15H] and hydrogen [14H] in an axisymmetric stagnation-point flow. Mass transfer into a laminar boundary layer on a flat plate is treated by a perturbation method [19H] or, alternatively, an integral method [20H].

For air injection into a hypersonic laminar boundary layer at high altitudes, the heating rate at the surface is a function of the catalytic efficiency of the surface; considering the boundary layer to be chemically "frozen," predictions are advanced for finite catalytic activity [4H]. It is quite possible that a mass-transfer coolant gas may react at the high energy level present in hypersonic flow. The extent of such combustion has been treated [25H, 27H], revealing that mass-transfer cooling is still very effective and the major result of such combustion is a slight increase in the amount of coolant required. Some insight into the influence of an unsteady free-stream velocity and a time-variable injection velocity has been obtained with an integral solution neglecting the variations with the distance along the plate [31H]. A rather detailed general study of transpiration cooling, including the treatment of heat transfer in the porous-wall structure as well as in the boundary layer, is given by Grootenhuis; the analytical results are compared with porous-plug experiments and available manufacturers of porous materials are listed [12H].

It is well known that the introduction of mass into the boundary layer in mass-transfer cooling may cause early transition to turbulence. Measurement was made of this effect at Mach 3.7, with helium and with air [24H]. As anticipated, at a given dimensionless mass-injection rate, helium resulted in a lower transition Reynolds number than for air [24H]. Faced with this possibility of turbulent flow occurring with mass-transfer cooling, van Driest presents predictions of heat transfer and friction for turbulent flow over transpiration-cooled spheres and cylinders [29H].

From a practical point of view, it may be simpler to supply the coolant material directly from the surface of the structure by either sublimation or evaporation rather than by transpiration cooling. Vaporization will result if the material is constructed of refractory oxides and the efficiency of this system under hypersonic flight conditions has been predicted [23H]. In such a vaporization process some energy penetrates into the remaining solid material; an approximate analysis has been accomplished [22H]. Experimental results with Teflon, another material which sublimes when exposed to extremely high temperatures, have been obtained and compared with a simplified analytical model [10H].

The melting which takes place when glassy materials are subjected to intensive heating may absorb sufficient energy to protect the remaining solid structure from destruction; simplified analytical studies have been advanced [2H, 18H]. Comparison of available approximate melting theories with a boundary-layer calculation suggests that all the approximate theories yield somewhat high heating and melting rates [28H]. Boundary-layer solutions are given for the rate of mass transfer from a moving gas to a moving liquid film and are quite comparable to the melting problem for a surface exposed to a high-temperature gas stream [1H].

In some applications it may be desirable to cool a local region rather than the entire surface—film cooling or transpiration cooling may then be feasible. Results of an analytical study using a finite-difference method for upstream transpiration cooling fall somewhere between the earlier work of Libby-Pallone and Rubesin-Inouye in prediction of adiabatic wall temperature [16H].

The adiabatic-wall-temperature distribution resulting from air-film-cooling a flat plate using an axial discharging slot has been investigated over a range of slot heights and for Mach numbers from zero to unity [21H]. A simple theoretical model has been advanced for correlating existing data on film cooling presumably valid for either air or helium injection [13H].

Investigation of sublimation from sharp-edged cylinders in flow parallel to the axis yielded information on the influence of surface curvature for both laminar and turbulent boundary layers applicable for the prediction of heat transfer [3H]. Spheres constructed of benzoic and cinnamic acids exposed to a flow of water yielded results on mass transfer (and consequently, heat transfer) over an extensive Reynolds-number range [8H, 26H]. The same spherical models were studied for laminar and turbulent free convection [9H].

Heat and mass-transfer results from a surrounding wall to a fluid flowing through a packed bed have been obtained [30H]. A similar analytical and experimental study was made of simultaneous transfer of heat and mass in porous media [7H]. Experiments and analysis of the effect of frost formation on the outer cylinder surface on the heat transfer between a humid air stream and the cylinder provided insight into the performance of evaporator coils [5H, 6H].

# Change of Phase

To give insight into the basic mechanism of boiling, additional analytical work has been done on the mechanics of bubbles. Considering the growth of vapor bubbles in an infinite medium, Scriven has obtained results with fewer restrictions than earlier works which are reported to be in considerable error for small superheating and for large vapor densities [15J]. A three-part mathematical analysis of the behavior of bubbles, beginning with single isolated bubbles, extending to single bubbles in the presence of another bubble or in the presence of a solid surface and finally to clouds of bubbles, has been published [25J]. Heat transfer from a superheated liquid to a vapor bubble in pool boiling has been investigated analytically, first considering independent spherical bubbles, and the results are used to interpret the earlier classical pictures taken by Fritz and Ende [13J].

Heat-transfer data for pool boiling of binary liquid mixtures demonstrate that increases in the peak heat-flux values are obtained when small amounts of a volatile component are present [23J]. The effects of wetting on boiling heat transfer have been studied. For stearic acid boiled on single copper crystals, wetting gives a higher heat-transfer performance in the relatively low-heat-flux free-convection regime, while at high heat fluxes wetting results in a decrease in the heat-transfer performance [4J]. Pool-boiling data for a number of organic materials of interest as reactor coolants were obtained and methods proposed for extending the results to other pressure levels and to forced-convection boiling [5J].

An intriguing study of boiling in the absence of gravity has been completed. A container of water in pool boiling was allowed to fall freely and high-speed photographs, Fig. 2, indicate that during this zero-gravity condition the vapor remains adjacent to the heating surface, and accordingly, there is greater danger of burnout [16J].

The various suggested mechanisms for the high heat fluxes in nucleate boiling are examined in detail. The large fluxes are considered due to a vapor-liquid exchange mechanism in which the bubbles transfer heat during their growth by pushing a quantity of hot fluid from the wall region into the outer stream; a summary of suggested correlations is given [3J]. A generalized simple equation for predicting surface boiling of liquids, applicable to both pool boiling and forced convection, has been advanced [9J].

As a result of extensive data taken at burnout for water flow through rectangular channels, a correlation is proposed for predicting burnout heat flux [17J]. Review of the present state of boiling knowledge in liquid-cooled-reactor technology, covering an introduction to bubble dynamics, two-phase flow, burnout, and so forth, is available [12J].

The wave-theory approach advanced by the author in an earlier paper was used to study heat transfer in film boiling with results claimed applicable to both free-convection and to film boiling [1J].

A boundary-layer treatment of steady-state laminar condensation first neglects the acceleration terms and then considers acceleration effects with the conclusion that the influence of acceleration is negligible for Prandtl numbers in excess of unity [18J]. Transient film condensation is studied wherein the surface temperature of a vertical plate suspended in a large body of stationary pure vapor at the saturation temperature is suddenly dropped to a point lower than the saturation conditions and transient condensation occurs. The solution, obtained by the method of characteristics, results in an estimate of time necessary to reach steady state [20J]. A somewhat similar problem considers a condensed phase initially at a uniform temperature exposed to a surface which suddenly is raised to a higher temperature so that evaporation occurs [7J]. An interesting proposal involves the use of a cooled rotating disk on which condensation occurs to replace the natural gravitational-force field by the centrifugal-force field [19J], and numerical results for a large range of Prandtl numbers are given.

The condensation of various combinations of vapor in the presence of a noncondensable gas were studied, including air-water, $CO_2$-water, helium-water, and $CO_2$-(n-Propyl alcohol), and compared with the established Colburn-Hougen method [23J]. Two-component oil-water flow studies in a smooth horizontal tube included determination of flow patterns and pressure drop [14J]. New results on air-water mixtures flowing in a vertical tube are available, including measured pressure drop and heat transfer [21J]. The influence of surface roughness on two-phase flow has been investigated in an air-water vertical-pipe system [6J]. Of considerable interest in two-phase flow is the local density; a radiation-attenuation method of determining local densities has been reported [11J].

Finally, several papers have appeared in the Russian literature including the effect of inlet conditions [10J] and tube length [20J] on burnout, the boiling of fine-grained materials [2J] and film condensation of pure vapor on vertical surfaces and horizontal pipes [8J].

**Fig. 2a** Pool boiling under normal gravity on a horizontal stainless-steel tube (diam = 0.157 in., length = 2.5 in.) at a heat flux of 127,000 Btu/hr-ft² (Ref. 16J).

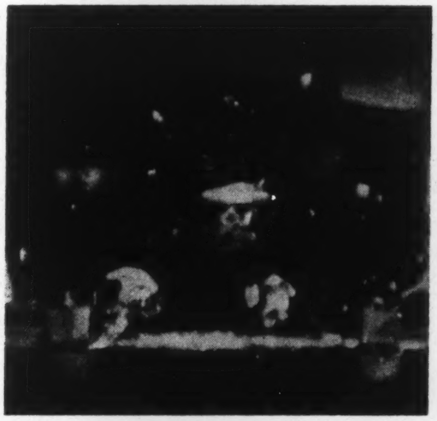
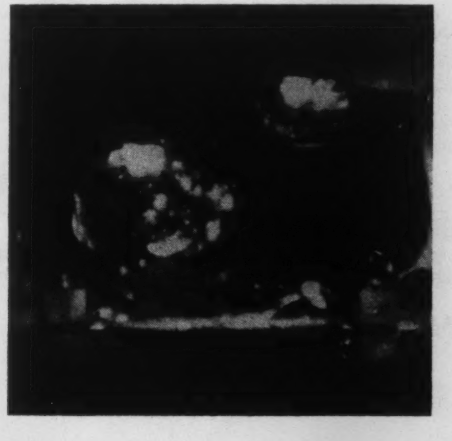


**Fig. 2b** Boiling at 5.5 per cent of normal gravity at a heat flux of 127,000 Btu/hr-ft²



# HEAT TRANSFER

## Radiation

An increased interest in the process of radiation in gases and the associated radiation properties has been evident. Papers [16K, 10K, 11K)] examined the relation between total gas absorptivities and emissivities and discussed theoretical models for predicting spectral properties. Comparisons are given between analysis and experiment for the case of water vapor. Another study [12K] finds that analytical techniques used in determining the total-radiation properties of carbon monoxide agree with theory within 20 per cent. Perspective on recent work on gas-radiation properties is given in a summary [7K].

The time variation of temperature, composition, ionization, and intensity of radiation has been calculated behind a normal shock in nitrogen [4K]. This type of problem has been the impetus for investigations on theoretical methods of determining radiation exchange such as [8K] and [15K] where the diffusion of radiation through gases with different scattering processes has been examined and [3K] where simultaneous energy transfer by convection and radiation in a Couette flow model was investigated for a radiation-absorbing gas.

Further information on the radiation properties of solids, particularly at high temperatures, has been published. The spectral emissivity of tungsten from 0.31 to 0.8 micron in the temperature range from 1600 to 2400 K has been measured [6K], as well as total hemispherical emissivities for oxidized nickel-titanium carbide from 600 to 1600 F [17K] and the spectral emissivities of uncoated and ceramic-coated Inconel and 321 stainless steel [14K]. In the latter investigation, various surface treatments are considered and the measurements were conducted in the 900 to 1800-F range over a wave-length range from 1.5 to 15 microns. Useful in spectroscopic investigations are the reflectivities of NaCl, KCl, and KBr crystals from 30 to 100 microns [9K].

A new thermal-radiation detector depends upon the expansion of a thin metallic strip and has greater sensitivity than more conventional thermopiles but at present is more affected by vibrations and thermal drift [5K]. Spectral-emissivity measurements of solids were described [1K] in which a solar furnace was used to obtain sample temperatures up to 3500 K.

The general expression for the solid angle subtended by a circular disk is presented in [13K]. The solution has the advantage of being expressed in terms of tabulated functions. The effect of internal radiation on the transient temperature distributions and thermal stresses of box beams is appreciable above 700 F and dominant above 1200 F [2K].

## Liquid Metals

The thermal entrance-region heat transfer has been analyzed for a liquid metal flowing turbulently through a channel. The restrictions were that the velocity profile is established (a uniform profile is assumed) at the location where heating is initiated and the wall temperature in the heated region is constant [5L, 6L].

A Russian contribution discusses the Martinelli-Lyon analysis for fully established forced convection to low-Prandtl-number fluids flowing turbulently through circular tubes with uniform wall heat flux, treating the effect of varying the ratio of eddy diffusivities and of variable physical properties [1L].

An experimental program covering the turbulent flow of bismuth, lead-bismuth, and sodium through circular tubes, encompassing a range of Peclet numbers from 100 to 11,000 and tube length-to-diameter ratios from 15 to 100 has been completed and suitable correlation equations advanced [2L]. Additional data are available for liquid metals flowing through both long and short test sections [3L]. Continued work is reported on the heat transfer to low-Prandtl-number fluids flowing over rod bundles [3L]. Some emphasis has been given during the year to free and to forced convection to liquid metals flowing over flat plates [1L, 3L, 7L]. The integral method was adopted in [1L], and exact boundary-layer solutions covering Prandtl numbers from 0.003 to 0.03 for both isothermal and constant-heat-flux boundary conditions in forced flow and for isothermal conditions in free convection in [7L].

Finally, in studying the heat transfer and fluid mechanics of a hot mercury stream flowing in the downward direction transferring heat directly to an upward-flowing water stream, a considerable amount of water was carried downward with the falling mercury drops thereby considerably reducing the anticipated heat-transfer performance [4L].

## Low-Density Heat Transfer

Artificial satellites and space vehicles operate in regions where the molecular mean free path is greater than the vehicle dimensions; hence it is understandable that heat transfer and drag in regions of low density are receiving greater attention.

An extensive experimental program reporting heat transfer to single cylinders (tungsten wires of 0.0002-in-diam), in subsonic crossflow in the slipflow region with Knudsen numbers from 0.009 to 0.077 gave results at the low Knudsen values which agreed well with the accepted continuum relations; data were obtained over a range of wall and free-stream temperature values, and rather complex nonlinear variable-property effects were reported [1M].

The subsonic-heat-transfer program was extended into the free-molecule flow range covering Knudsen numbers from 0.10 to 5.0 [2M]. Measured recovery temperatures suggested that the minimum Knudsen number for free-molecule flow is approximately 5; in this region the measured heat transfer from the tungsten wires gave good agreement with free-molecule-flow predictions when an accommodation coefficient of 0.57 was assumed [2M]. Local values of the heat transfer, recovery temperature, and pressures around a circular cylinder normal to an air stream with Mach numbers from 1.3 to 5.9 and Reynolds numbers from 37 to 4100 are available [8M].

Analysis of the velocity and temperature discontinuity in slip flow requires modification of the classical expressions to account for the mean motion of the gas [5M, 7M]. Assuming that the normal boundary-layer equations still apply in slip flow, with the boundary conditions modified to take into account the slip conditions at the wall, the heat-transfer and recovery factors for a flat plate are presented [5M]. The temperature distribution in a rarefied gas between two parallel plates was analyzed and appropriate heat-transfer measurements were accomplished to evaluate the unknown constants [3M].

Satellites move at much higher velocities than the mean thermal speed of the surrounding air molecules, a condition designated as "hyperthermal free-molecule flow." The thermal motion of the molecules may be ignored to simplify calculations of drag and heat transfer. An analytical model for the molecule-surface interaction is proposed and the drag is calculated for a number of shapes including a random tumbling satellite [6M].

In measuring the accommodation coefficient for mass transfer (evaporation) from spheres at low densities, it is emphasized that heat transfer must be taken into account, since the energy necessary for evaporation must come to the surfaces, resulting in a temperature depression at the surface [4M].

## Measurement Techniques

Considerable interest has been shown in the measurement of radiation properties in the atmosphere. A new radiometer [7N] permits direct measurements of the radiative-flux divergence in the lowest few meters of the atmosphere. Another instrument [1N] is a null-type device which measures the equivalent black-body radiation temperature in the upper atmosphere at night.

Portable radiation instrumentation includes a black body [15N] designed with a conical shape, interior temperature uniformity of 1 C, total emissivity of 0.99, and a black-body area of 1 sq ft, usable from 10 to 90 C, and a radiometer with 20-sec time response for measuring solar radiation in the vicinity of the ground [20N] and a sensitivity of 5.5 mv per cal-cm$^2$-min.

For measurements in plasmas, a recording pyrometer [5N] measures brightness temperatures at 0.65 micron in the 1300 to 3000 C range, and a technique [27N] for measuring transient temperatures based on the Langmuir single probe method has cathode-ray-oscilloscope display.

Probes for measuring temperatures in high-velocity gas streams include a diffusion-type total-temperature probe [24N], a specially designed probe with an effective recovery factor of unity or greater [22N], and a cooled-gas pyrometer [14N]. A free-molecule probe [16N] is used as an instrument in determining state information in two-dimensional rarefied gas flows.

Refractory-metal thermocouples containing Rhenium are discussed [25N] for service to 2200 C. They must be used in a vacuum or reducing atmosphere but produce nearly double the thermoelectric power at 600 C of standard pt-pt-10 per cent Rh couples. A thin wire (0.01-in.) welded onto a platinum sheet which serves as part of the thermocouple circuit is described [18N].

A null-reading manometer for sensing differential pressures below 5 mm. of water has a probable error less than 0.01 mm of water [13N]. Ultrasonic calibration of pitot tubes [8N] is particularly applicable to air speeds smaller than 10 fps.

Maintaining an object or zone at a uniform temperature is analyzed for the degree to which a body suspended in a chamber can have its temperature remain constant [6N]. A moving gas stream is used to maintain isothermal conditions in the range from $-150$ to $+200$ C [2N].

Two errors in temperature measurement with mercury thermometers are discussed [9N] with design procedures for minimizing the uncertainties due to emergent column contraction and irregularity of movement of the mercury miniscus. Permanent and continuous recordings can be obtained of the temperature sensed by a resistance thermometer used in conjunction with a G-3 Mueller bridge [3N]. The system offers several advantages over the use of an ordinary optical galvanometer when investigating transient phenomena at high precisions of the order of $10^{-4}$ C.

Three methods for the experimental determination of the thermal conductivity of small porous particles of approximately 0.4 cm diam are described and compared [23N]. To increase the sensitivity and stability of thermistor thermal-conductivity gas cells [29N], it is recommended that they be immersed in an ice bath and that internal gas pressure be regulated precisely. The electrolytic tank is used in solving anisotropic conduction problems both by geometry-expansion and liquid-resistivity change in particular directions [12N].

The utilization of evaporated-film resistance thermometers to investigate heat-exchanger performance is analyzed in [17N] and application in aerodynamic heat-transfer research is discussed in [10N]. A method of constant-resistance hot-wire anemometry [11N] has several inherent advantages over the constant-current technique. Both methods are compared for measuring the turbulent energy decay behind a wire grid.

Photographic techniques for evaluating bulk collectors of radiant energy such as solar furnaces are discussed [4N]. Both the total amount of energy concentration and the uniformity of concentration may be determined. A high-speed multiple-spark light source suitable for photographic systems of shock tunnels, shock tubes, and ballistic ranges has been designed [28N]. Calibration of gas flowmeters by measuring the time required to pressurize a known volume from near vacuum to one atmosphere of pressure [26N] requires no vapor pressure or dissolved-gas corrections as in the more usual water-displacement technique. A gamma-ray attenuation technique for measuring density and phase distribution in two-phase fluids [21N] is evaluated by a series of tests made on an air-water system at atmospheric pressure.

It is difficult to make relative-humidity determinations above 95 per cent because the wet-bulb depression is small. By using thermocouples where a current through one couple causes cooling and condensation and this couple is then used as the wet-bulb-temperature sensor, the depression can be read to $10^{-3)}$ C [19N].

## Heat Transfer Applications

**Heat Exchangers.** Heat-exchanger design papers have dealt mainly with the development of simpler calculation techniques and the reporting of experimental heat-transfer data on various types of common arrangements.

Convenient methods for predicting heat-transfer coefficients on the shell side with water flow [1P] are limited to segmented and baffled tubular exchangers. A companion study [2P] discusses procedures to find shell-side heat transfer and pressure drop in transverse-finned shell-and-tube exchangers. Correlation equations [5P] relate the outside heat-transfer coefficient in finned crossflow heat exchangers with Reynolds modulus and number of rows.

Heat-transfer and pressure-drop measurements for air flow normal to finned and unfinned tubes [8P] were designed to investigate conditions where physical-property variations are significant. Design considerations are related to extended surfaces in [9P] and heat-transfer, pressure-drop, and economic factors are analyzed. A pair of papers [10P, 3P] deals with heat-transfer characteristics of wire-and-tube heat exchangers.

Transient conduction solutions are used to analyze performance of a rotating-drum cooler-flaker [7P]. An electric-analog investigation has been made of the heat-transfer characteristics of a crossflow heat exchanger [6P] in which a gas and a liquid metal were the two fluids.

The use of numerical methods to calculate transient temperature in heat exchangers [4P] considers digital-computer programming. Calculation of starting transients in a gas-turbine regenerator is used as an illustration.

**Aircraft, Missiles, and Satellites.** The heat transfer in the re-entry of a missile or satellite is excellently summarized in [4Q]. A study of the motion and aerodynamic heating of ballistic missiles during re-entry [1Q] established that either blunt or slender shapes require the least amount of coolant, depending on the missile weight. No shape between the two extremes should be used. A minimum amount of the maximum rate of heat flux is always obtained by a blunt shape. Heat sinks, radiation cooling, ablation, and transpiration cooling were discussed as possible cooling methods during re-entry in [2Q]. Temperature measurements on the skin of a wing attached to a slender missile which was propelled by a two-stage rocket established Stanton numbers in reasonably good agreement with values calculated for turbulent-boundary-layer flow over a flat plate [7Q]. Proper heat addition underneath an airfoil increases its lift considerably [5Q].

Cooling methods surveyed for gas-turbine blades included internal convection cooling and transpiration cooling [3Q]. Several transpiration-cooled blades with a shell of "poralloy" wire cloth were attached to a gas-turbine wheel and one blade operated satisfactorily for 33 hr with 11 per cent coolant flow while the others failed within 10 min. Transpiration cooling of gas-turbine blades was demonstrated to be potentially feasible although the methods of attaching the shell have to be improved [6Q].

**Electric Equipment.** Electric analogs were used for determining the temperature distribution and heat flow in electrical equipment [1R, 3R] in which an electrolytic tank was successfully used to find the thermal characteristics of a high-performance generator coil [1R]. The external cooling of cylindrical electrical components by forced and free convection and by radiation has been studied in an environmental test chamber, and the results are compared with the predictions of simple calculation methods [2R]. The steps of a procedure for selecting cooling requirements in terms of reliability requirements have been outlined [4R].

## References

### Conduction

1A Boit, M. A., *J. Aeronaut. Space Sci. 26*, 367 (1959).
2A Brul, M. A., Vinson, J. R., Ibid. 25, 742 (1958).
3A Creswick, F. A., *Ind. Math. 8*, 61 (1957).
4A Demetriades, A., *ARS Journal 29*, 653 (1959).
5A Diebold, E. J., Luft, W., *Trans. AIEE, 77*, 739 (1958).
6A Duffin, R. J., *J. Math. Mech. 8*, 47 (1959).
7A Friedman, A., Ibid. *8*, 161 (1959).
8A Gibson, R. E., *Quart, Appl. Math. 16*, 426 (1959).
9A Hofmann, R., *Z. angew. Math. u. Phys. 10*, 233 (1959).
10A Keller, H. H., Somers, E. V., *Trans. ASME—J. Heat Transfer 81*, Series C, 151 (1959).
11A Kirkpatrick, E. T., Stockey, W. F., Ibid. *81*, Series C, 54 (1959).
12A Laubitz, J. J., *Canad. J. Physics 37*, 798 (1959).
13A McFarland, B. L., *J. Appl. Phys. 29*, 1682 (1958).
14A Mirsepassi, T. J., *British Chem. Eng. 4*, 130 (1959).
15A Murray, W. D., Landis, F., *Trans. ASME—J. Heat Transfer 81*, Series C, 106 (1959).
16A Newcomb, T. P., *British J. Appl. Phys. 9*, 456 (1958).
17A Ibid. *10*, 204 (1959).

18A Paschkis, V., *Trans. ASME—J. Heat Transfer 81*, Series C, 144 (1959).

19A Shuleshko, P., *Australian J. Appl. Sci. 10*, 1 (1959).

20A Ibid. *10*, 9 (1959).

21A Thomsen, J. S., *AIChE Journal* 5, 268 (1959).

22A Trimpi, R. L., Jones, R. A., Natl. Advisory Comm. Aeronaut., Tech. Note *4308*, (1958).

23A Vodicka, V., *J. Phys. Soc. Japan 14*, 216 (1959).

24A Ibid. *14*, 959 (1959).

25A Wolfe, W. A., *Trans. ASME—J. Heat Transfer 81*, Series C, 19 (1959).

26A Yavorsky, P. M., Friedrich, R. J., Gorin, E., *Ind. Eng. Chem. 51*, 833 (1959).

### Channel Flow

1B Ber, L. E., *Soviet Phys.-Tech. Phys. 4*, 52 (1959).

2B Cess, R. D., *J. Aero/Space Sci.* 25, 723 (1958).

3B Darling, G. B., *Petroleum* 22, 177 (1959).

4B Deissler, R. G., Taylor, M. F., Natl. Advisory Comm. Aeronaut., Tech. Note *4384* (1958).

5B Deissler, R. G., Weiland, W. F., Lowdermilk, W. H., ibid., Tech. Note *4376* (1958).

6B Eckert, E. R. G., Irvine, T. F., Jr., *Trans. ASME 80*, 1765 (1958).

7B Friend, W. L., Metzner, A. B., *AIChE Journal 4*, 393 (1958).

8B Gershuni, G. Z., Zhukhovitskii, E. M. *Soviet Phys.-JETP 34*(7), No. 3, 670 (1958).

9B Hans, L. S., *Trans ASME—J. Heat Transfer 81*, Series C, 121 (1959).

10B Hardebol, J., *Ingenieur 71*, (no. 25), 0, 25 (1959).

11B Hunziker, R. R., *Z. angew. Math. u. Phys. 9a*, 307 (1958).

12B Lancet, R. T., *Trans. ASME—J. Heat Transfer 81*, Series C, 168 (1959).

13B Levy, S., Fuller, R. A., Niemi, R. O., Ibid. *81*, Series C, 129 (1959).

14B Maslen, S. H., Natl. Advisory Comm. Aeronaut., Tech. Note *4319* (1958).

15B Metzner, A. B., Friend, P. S., *Ind. Eng. Chem. 51*, 879 (1959).

16B Morrell, G., *Jet Propulsion 28*, 829 (1958).

17B Petukhov, B. S., Krasnoshchekov, E. A., *Soviet Phys.-Tech. Phys.* 3, 1123 (1959).

18B Price, P. H., *Brit. J. Appl. Phys. 10*, 135 (1959).

19B Regirer, S. A., *Appl. Math. and Mechanics* 22, 580 (1958).

20B Resler, E. L., Jr., Sears, W. R., *Z. angew. Math. u. Phys. 9b*, 509 (1958).

21B Siegel, R., *J. Appl. Mech. 26*, *Trans. ASME 81*, Series E, 140 (1959).

22B Siegel, R., Sparrow, E. M., *AIChE Journal* 5, 73 (1959).

23B Siegel, R., Sparrow, E. M., *Trans. ASME—J. Heat Transfer 81*, Series C, 29 (1959).

24B Soo, S. L., *Z. angew. Math. u. Phys. 10*, 291 (1959).

25B Sparrow, E. M., Siegel, R., *Trans. ASME—J. Heat Transfer 81*, Series C, 157 (1959).

26B Sparrow, E. M., Siegel, R., Proc. Third U. S. Nat. Congr. Appl. Mech., June, 1958, 817 (1958).

27B Taylor, M. F., Kirchgessner, T. A., Natl. Aeronaut. Space Adm. Tech. Note *D-133* (1959).

### Boundary-Layer Flow

1C Appleton, J. P., Davies, H. J., *J. Aero/Space Sci.* 25, 722 (1958).

2C Bandettini, A., Isler, W. E., Natl. Aeronaut. Space Adm. Memo *12-25-58A* (1959).

3C Bertram, M. H., Feller, W. V., Ibid. Memo *5-24-59L* (1959).

4C Bleviss, Z. O., *J. Aero/Space Sci.* 25, 601 (1958).

5C Boison, J. C., Curtiss, H. A., *ARS Journal 29*, 130 (1959).

6C Bourne, D. E., Davies, D. R., Wardle, S., *Quart. J. Mechanics Appl. Math. 12*, part 2, 257 (1959).

7C Brunk, W. E., Natl. Advisory Comm. Aeronaut. Tech. Note *4380* (1958).

8C Carter, H. S., Ibid., Tech. Note 4333 (1958).

9C Chang, C. C., Lundgren, T. S., Proc. 1959 Heat Transfer and Fluid Mechanics Inst., p. 41, Stanford Univ. Press, Calif. (1959).

10C Cohen, N. B., Natl. Aeronaut. Space Adm. Memo *1-2-59L* (1959).

11C Cooper, M., Mayo, E. E., Ibid. Memo *1-3-59L* (1959).

12C Durgin, F. H., *J. Aero/Space Sci. 26*, 450 (1959).

13C Ede, A. J., Saunders, O. A., *Proc. Institution of Mechanical Engineers 172*, 743 (1958).

14C Eggers, A. J., Jr., Hansen, C. F., Cunningham, B. E., Natl. Advisory Comm. Aeronaut., Tech. Note *4229* (1958).

15C Frössling, N., *Archiv. for Fysik 14*, 143 (1958).

16C Golitsyn, G. S., *Soviet Physics-JETP 34* (3), 688 (1958).

17C Golitsyn, G. S., Stanyukovich, K. P., Ibid. 33(*6*), 1417 (1957).

18C Goulard, R., *Jet Propulsion 28*, 737 (1958).

19C Hassan, H. A., *J. Aero/Space Sci. 26*, 464 (1959).

20C Hess, R. V., Natl. Aeronaut. Space Adm. Memo *4-9-59L* (1959).

21C John, R. R., Bade, W. L., *ARS Journal 29*, 523 (1959).

22C Johnson, D. S., *J. Appl. Mechanics 26*, *Trans. ASME 81*, Series E, 325 (1959).

23C Jones, J. J., Natl. Aeronaut. Space Adm. Memo *6-10-59L* (1959).

24C Ibid., Tech. Note *D-54* (1959).

25C Kakutani, T., *J. Phys. Soc. Japan 13*, 1504 (1958).

26C Kapur, J. N., *Appl. Sci. Res. Sec. A. 8*, 198 (1959).

27C Kemp, N. H., Rose, P. H., Detra, R. W., *J. Aero/Space Sci. 26*, 421 (1959).

28C Lam, S. H., Crocco, L., Ibid. *26*, 54 (1959).

29C Meyer, R. C., Ibid. *25*, 561 (1958).

30C Meyer, R. X., *ARS Journal 29*, 187 (1959).

31C Reshotko, E., Beckwith, I. E., Natl. Advisory Comm. Aeronaut., Report *1379* (1958).

32C Reynolds, W. C., Kays, W. M., Kline, S. J., Natl. Aeronaut. Space Adm., Memos *12-1-58W*, *12-2-58W*, *12-3-58W*, *12-4-58W* (1958).

33C Rose, P. H., Probstein, R. F., Adams, M. C., *J. Aero/Space Sci. 25*, 751 (1958).

34C Rosner, D. E., *ARS Journal 29*, 215 (1959).

35C Rosner, D. E., *J. Aero/Space Sci. 26*, 384 (1959).

36C Rossow, V. J., Natl. Advis. Comm. Aeron., Rept. *1358* (1958).

37C Rutowski, R. W., Proc. 1959 Heat Transfer and Fluid Mechanics Inst., p. 110. Stanford Univ. Press, Calif. (1959).

38C Sands, N., Jack, J. R., Natl. Advisory Comm. Aeronaut., Tech. Note *4378* (1958).

39C Scala, S. M., Proc. Third U. S. National Congr. Appl. Mech., June, 1958, p. 99 (1958).

40C Seiff, A., Short, B. J., Natl. Advisory Comm. Aeronaut., Tech. Note *4364* (1958).

41C Sibulkin, M., *Jet Propulsion 28*, 548 (1958).

42C Sparrow, E. M., Natl. Aeronaut. Space Adm., Tech. Note *D-77* (1959).

43C Sparrow, E. M., Gregg, J. L., *J. Appl. Mechanics 26*, *Trans. ASME 81*, Series E, 161 (1959).

44C Sparrow, E. M., Gregg, J. L., Natl. Aeronaut. Space Adm., Memo *2-27-59E* (1959).

45C Sugawara, S., Sato, Y., Komatsu, H., Osaka, H., Natl. Advisory Comm. Aeronaut., Tech. Memo *1441* (1958).

46C Vaglio-Laurin, R., *ARS Journal 29*, 123 (1959).

47C Wadsworth, J., Natl. Res. Council Canada, Div. Mech. Engng., Rept. MT-39 (1958).

48C Wisniewski, R. J., NASA Memo *10-1-58E* (1958).

49C Wrage, E., Deutsche Versuchsanstalt für Luftfahrt, Report 81, Westdeutscher Verlag, Köln (1958).

50C Yang, K. T., *J. Appl. Mechanics 26*, 171 (1959).

51C Ibid. 25, 421 (1958).

52C Zakkay, V., *J. Aero/Space Sci.* 25, 794 (1958).

### Flow With Separated Regions

1D Baldwin, L. V., Natl. Advisory Comm. Aeronaut., Tech. Note *4369* (1958).

2D Carlson, W. O., Proc. 1959 Heat Transfer and Fluid Mechanics Inst., p. 140, Stanford Univ. Press, Calif. (1959).

3D Koch, R., *VDI Forschungsheft 24*, No. 469 (1958).

4D Ostroumov, G. A., *Soviet Physics-Technical Physics 28*, 1575 (1958).

5D Rabinowicz, J., *Jet Propulsion 28*, 615 (1958).

6D Ragsdale, R. G., Natl. Aeronaut. Space Adm., Memo *10-9-58E* (1958).

7D Vickers, J. M. F., *Ind. Eng. Chem. 51*, 967 (1959).

8D Vreedenberg, H. A., *Chem. Eng. Sci. 9*, 52 (1958).

9D Yagi, S., Wakao, N., *AIChE Journal* 5, 79 (1959).

### Transfer Mechanism

1E Ackeret, J., Natl. Aeronaut. Space Adm., Tech. Transl. *F-2* (1959).

2E Barrow, H., *Roy. Aeronaut. Soc. Journal 63*, 180 (1959).

3E Bourne, D. E., *J. Aero/Space Sci. 26*, 459 (1959).

4E Braslow, A. L., Knox, E. C., Horton, E. A., Natl. Aeronaut. Space Adm., Tech. Note *D-53* (1959).

5E Görtler, H., Witting, H., Symposium Freiburg/Br. 26 to 29, August, 1957, Springer-Verlag/Berlin-Göttingen-Heidelberg (1958).

6E Hall, I. M., Berry, J., *J. Aero/Space Sci. 26*, 253 (1959).

7E James, C. S., Natl. Advisory Comm. Aeronaut., Tech. Note *4235* (1958).

8E Kirchgassner, K., Deutsche Versuchsanstalt für Luftfahrt E. V., Bericht Nr. 75, Westdeutscher Verlag Köln und Opladen, (1958).

9E Klebanoff, P. S., Tidstrom, K. D., Natl. Aeronaut. Space Adm., Tech. Note D-195 (1959).

10E Kline, S. J., Runstadler, P. W., *J. Appl. Mechanics 26*, *Trans. ASME 81*, Series E, 166 (1959).

11E Metzner, A. B., Friend, W. L., *Canadian J. Chem. Engn. 36*, 235 (1958).

# HEAT TRANSFER

12E Rietema, K., Krajenbrink, H. J., *Appl. Sci. Res., Sec. A 8*, 177 (1959).
13E Robinson, G. C., McClure, C. M., III, Hendricks, R., Jr., *Am. Cer. Soc. Bul.* 37, 399 (1958).
14E Smith, A. M. O., Clutter, D. W., *J. Aero/Space Sci. 26*, 229 (1959).
15E Squire, W., *Appl. Sci. Res., Sec. A. 8*, 158 (1959).
16E Torocheshnikov, N. S., Leites, I. L., Brodyanskii, V. M., *Soviet Physics-Technical Physics 28*, 1229 (1958).
17E Witting, H., *Archive for Rational Mech. and Analysis* 2, 243 (1959).
18E Yih, C. S., *Phys. of Fluids* 2, 125 (1959).

## Natural Convection

1F Acrivos, A., *AIChE Journal 4*, 285 (1958).
2F Brown, W. G., Grassmann, P., *Forsch, Ing. Wes.* 25, 69 (1959).
3F Carrier, G. F., Chang, C. T., *Quart. Appl. Math. 16*, 436 (1959).
4F Fujii, T., *Trans. Jap. Soc. Mech. Engrs.* 24, 957 (1958).
5F Ibid. 24, 964 (1958).
6F Ibid. 24, 973 (1958).
7F Gershuni, G. Z., Zhukhovitskii, E. M., *Soviet Physics-JETP 34*(7), No. 3, 465 (1958).
8F Globe, S., Dropkin, D., *Trans. ASME—J. Heat Transfer 81*, Series C, 24 (1959).
9F Gupta, A. S., *Appl. Scientific Res., Sec. A. 8*, 309 (1959).
10F Hama, F. R., Recesso, J.V., Christeaens, J., *J. Aero/Space Sci. 26*, 335 (1959).
11F Hanratty, T. J., Rosen, E. M., Kabel, R. L., *Indust. Engng. Chem. 50*, 815 (1958).
12F Hara, T., *Bul. Jap. Soc. Mech. Engrs. 1*, 251 (1958).
13F Hartnett, J. P., Welsh, W. E., Jr., Larsen, F. W., *Chem. Eng. Prog., Svmposium Series 55*, (No. 23), 85 (1959).
14F Ibl, N., Müller, R. H., *J. Electrochemical Society 105*, 346 (1958).
15F Jackson, T. W., Harrison, W. B., Coteler, W. C., *Trans. ASME—J. Heat Transfer 81*, Series C, 68 (1959).
16F Mabuchi, I., *Trans. Jap. Soc. Mech. Engrs.* 23, 259 (1957).
17F Ostroumov, A. G., Ostroumov, G. A., *Soviet Physics-Technical Physics 1*, 610 (1956).
18F Ostroumov, G. A., *Ibid.* 3, 1452 (1959).
19F Petukhov, B. S., Nol 'de, L. D., *Teploenergetika 6*, 72 (1959).
20F Poots, G., *Quart. J. Mechanics Appl. Math. 11*, 257 (1958).
21F Randall, I. E., Sesonske, A., *AIChE Journal* 5, 150 (1959).
22F Sevruk, I. G., *Appl. Math. Mechanics* 22, 587 (1958).
23F Sidorov, E. A., *Teploenergetika 4*, 79 (1958).
24F Smirnov, A. G., *Soviet Physics-Technical Physics* 3, 1429 (1958).
25F Soberman, R. K., *Phys. of Fluids* 2, 131 (1959).
26F Sparrow, E. M., Eichorn, R., Gregg, J. L., Ibid. 2, 319 (1959).
27F Sparrow, E. M., Gregg, J. L., *J. Appl. Mech. 26*, *Trans. ASME 81*, 133 (1959).
28F Sparrow, E. M., Gregg, J. L., Natl. Aeronaut. Space Adm., Memo *2-27-59E* (1959). *also Z. angew. Math. u. Phys. 9a*, 383 (1958).
29F Stewartson, K., *Z. angew, Math. u. Phys. 9a*, 276 (1958).
30F Wooding, R. A., *J. Fluid Mech.* 3, 582 (1958).
31F Yamagata, K., *Trans. Jap. Soc. Mech. Engrs. 24*, 541 (1958).
32F Yih, C. S., *Quart. Appl. Math. 17*, 25 (1959).

## Convection from Rotating Surfaces

1G Bjorklund, I. S. and Kays, W. M., *Trans ASME—J. Heat Transfer 81*, Series C, 175 (1959).
2G Broecker E., *Zeitschrift für Angewandte Mathematik und Mechanik 39*, 68, (1959).
3G Davies, D. R., *Quart. J. Mech. and Appl. Math. 12*, Part 2, 211 (1959).
4G Dorfman, L. A., *Soviet Phys.-"Doklady"* 3, 248 (1958).
5G Dropkin, D., Globe, S., *J. Appl. Phys. 30*, 84 (1959).
6G Kreith, F., Taylor, J. H., Chang, J. P., *Trans. ASME—J. Heat Transfer 81*, Series C, 95 (1959).
7G Seban, R. A., Johnson, H. A., Natl. Aeronaut. Space Adm. Memo *4-22-59W* (1959).
8G Sparrow, E. M. and Gregg, J. L., *Trans. ASME—J. Heat Transfer 81*, Series C, 249 (1959).
9G Tirskii, G. A., *Soviet Phys.-"Doklady,"* 3, 237 (1958).

## Combined Heat and Mass Transfer

1H Acrivos, A., *Chem. Eng. Sci. 9*, 242 (1959).
2H Bethe, H. A., Adams, M. C., *J. Aero/Space Sci. 26*, 321 (1959).
3H Christian, W. J., Kezios, S. P., *AIChE Journal* 5, 1 (1959).
4H Chung, P. M., Natl. Aeron. Space Adm. Tech. Note *D*-27 (1959).
5H Chung, P. M., Algren, A. B., *Heating, Piping and Air Conditioning 30*, No. 9, 171 (1958).
6H Ibid. No. 10, 115.
7H deVries, D. A., *Trans. Amer. Geophys. Un. 39*, 909 (1958).
8H Garner, E. H., Keey, R. G., *Chem. Eng. Sci. 9*, 119 (1958).
9H Ibid. 218.
10H Georgiev, S., others, Heat Transfer and Fluid Mechanics Inst., 171. Stanford University Press (1959).
11H Gribben, R. J., *Phys. of Fluids*. 2, 305 (1959).
12H Grootenhuis, P., *J. Roy Aero. Soc. 63*, No. 578, 73 (1959).
13H Hatch, J. E., Papell, S. S., Natl. Aeronaut. Space Adm. Tech. Note D-130 (1959).
14H Hayday, A. A., Heat Transfer and Fluid Mechanics Inst., 156. Stanford University Press (1959).
15H Hoshizaki, H., Smith, H. J., *J. Aero/Space Sci. 26*, 399 (1959).
16H Howe, J. T., Natl. Aeronaut. Space Adm. Memo *2-26-59A* (also ASTA AD-210 522) (1959).
17H Howe, J. T., Mersman, W. A., Natl. Aeronaut. Space Adm. Tech. Note D-12 (1959).
18H Lees, L., *ARS Journal 29*, 354 (1959).
19H Merk, H. J., *Appl. Sci. Res.* (A) *8*, 237 (1958).
20H Ibid. 261.
21H Papell, S. S., Trout, A. M., Natl. Aeronaut. Space Adm. Tech. Note D-9 (1959).
22H Roberts, L., Natl. Aeronaut. Space Adm. Tech. Note *D-41* (1959).
23H Scala, S. M., Heat Transfer and Fluid Mechanics Inst., 181, Stanford University Press (1959).
24H Scott, C. J., Anderson, G. E., *J. Aero/Space Sci. 25*, 791 (1958).
25H Spalding, D. B., *ARS Journal 29*, 666 (1959).
26H Steele, L. R., Geankoplis, C. J., *AIChE Journal 5*, 178 (1959).
27H Sutton, G. W., *ARS Journal 29*, 136 (1959).
28H Sutton, G. W., *J. Aero/Space Sci. 26*, 397 (1959).
29H van Driest, E. R., *Zeitschrift für Angewandte Mathematik und Physik 9b*, Nos. 5 and 6, 233, (1959).
30H Yagi, S., Wakao, N., *AIChE Journal 5*, 79 (1959).
31H Yang, K. T., *J. Aero/Space Sci. 26*, 653 (1959).

## Change of Phase

1J Chang, Y. P., *Trans. ASME—J. Heat Transfer 81*, Series C, 1 (1959).
2J Dement'ev, V. M. *Teploenergetika, 6*, No. 1, 50 (1959).
3J Engelberg-Forster, K., Greif, R., *Trans. ASME—J. Heat Transfer, 81*, Series C, 43, (1959).
4J Harrison, W. B., Levine, Z., *AIChE. Journal 4*, 409 (1958).
5J Jordan, D. P., Leppert, G., *Nuclear Sci. and Engng. 5*, 6 (1959).
6J Katsuhara, T., *Trans. Jap. Soc. Mech. Engrs. 24*, 1050 (1958).
7J Knuth, E. L., *Phys. of Fluids* 2, 84 (1959).
8J Laboontzov, D. A., *Teploenergetika, 4*, No. 7, 72 (1957).
9J Levy, S., *Trans. ASME—J. Heat Transfer 81*, Series C, 37 (1959).
10J Miropol'skii, Z. L., Shitsman, M. E., Mostinskii, I. L., Stravrovskii, A. A., *Teploenergetika 6*, No. 1, 80 (1959).
11J Petrick, M., Swanson, B. S., *Rev. Sci. Inst., 29*, 1079 (1958).
12J Roberts, H. A., Bowring, R. W., *Nuclear Power, 4*, No. 34, 69 (1959).
13J Ruckenstein, E., *Chem. Eng. Sci. 10*, 22 (1959).
14J Russell, T. W. F., Hodgon, G. W., Govier, G. W., *Can. J. Chem. Eng.*, 37, 9 (1959).
15J Scriven, L. E., *Chem. Eng. Sci. 10*, 1 (1959).
16J Siegel, R., Usiskin, C. M., *Trans. ASME—J. Heat Transfer 81*, Series C, 230 (1959).
17J Sonnemann, G., *Nuclear Sci. and Engng. 5*, 242 (1959).
18J Sparrow, E. M., Gregg, J. L., *Trans. ASME—J. Heat Transfer 81*, Series C, 13 (1959).
19J Sparrow, E. M., Gregg, J. L., *Trans. ASME—J. Heat Transfer 81*, Series C, 113 (1959).
20J Sparrow, E. M., Siegel, R., *J. Appl. Mech. 26*, *Trans. ASME 81*, Series E, 120 (1959).
21J Styrikovich, M. A., Faktorovich, L. E., *Soviet Phys-Doklady*, 3, 518 (1959).
22J Ueda, T., *Bull. of Jap. Soc. Mech. Engrs. 1*, 139 (1958).
23J van Stralen, S. J. D., *Brit. Chem. Engng. 4*. No. 1, 8 (1959).
24J Votta, F., Jr., Walker, C. A., *AIChE Journal 4*, 413 (1958).
25J Zwick, S. A., *J. Math. Phys.* 37, 246 (1959).

## Radiation

1K Glaser, P. E., Blau, H. Y., Jr., *Trans ASME—J. Heat Transfer 81*, Series C, 92 (1959).
2K Goodman, S., Russell, S. B., Noble, C. E., *Journal Research of the N.B.S. 62*, 145 (1959).
3K Goulard, R., Goulard, M., Proc. 1959 Heat Transfer and Fluid Mechanics Inst., p. 126, Stanford Univ. Press, Calif. (1959).

4K Hammerling, P., Teare, J. D., Kwel, B., *Phys. of Fluids* 2, 422 (1959).

5K Jones, R. V., *Proc. Roy. Soc. Lond. (A) 249*, 100 (1959).

6K Larrabee, R. D., *J. of the Optical Soc. of America 49*, 619 (1959).

7K Logan, J. G., Jr., *Jet Propulsion 28*, 795 (1958).

8K Minin, I. N., *Soviet Physics, "Doklady"* 3, 535 (1958).

9K Mitsuishi, A., Yoshinaga, H., Fujita, S., *J. Phys. Soc. Japan 14*, 110 (1959).

10K Olfe, D., Penner, S. S., *J. Appl. Phys. 30*, 125 (1959).

11K Ibid. *30*, 953 (1959).

12K Oppenheim, U. P., *J. Appl. Phys. 30*, 803 (1959).

13K Paxton, F., *Rev. of Sci. Instr.* 30, 254 (1959).

14K Richmond, J. C., Stewart, J. E., Natl. Aeronaut. Space Adm., Memo *4-9-59W* (1959).

15K Sobolev, V. V., *Soviet Physics "Doklady"* 3, 541 (1958).

16K Thomson, A., Hooker, W. J., Penner, S. S., *J. Appl. Phys. 30*, 124 (1959).

17K Wade, W. R., Casey, F. W., Jr., Natl. Aeronaut. Space Adm., Memo *5-13-59L* (1959).

### Liquid Metals

1L Borishanskii, V. M., Kutateladze, S. S., *Soviet Physics-Technical Physics* 3, 781 (1958).

2L Kutateladze, S. S., Ibid. 3, 792 (1958).

3L Kutateladze, S. S., Borishanskii, V. M., Novikov, I. I., *Atomnaya Energiya 4*, 422 (1958).

4L Pierce, R. D., Sawyer, O. E., Martin, J. J., *AIChE Journal* 5, 257 (1959).

5L Poppendiek, H. F., Natl. Aeronaut. Space Adm. Memo 2-5-*59W* (1959).

6L Poppendiek, H. F., *Nuclear Sci. and Engng. 5*, 390 (1959).

7L Sparrow, E. M., Gregg, J. L., Natl. Aeronaut. Space Adm. Memo 2-*27-59E* (1959).

### Low-Density Heat Transfer

1M Baldwin, L. V., Natl. Advisory Comm. Aeronaut. Tech. Note *4369* (1958).

2M Cybulski, R. J., Baldwin, L. V., Natl. Aeronaut. Space Adm. Memo *4-27-59E* (1959).

3M Fujimoto, T., Takao, K., *Trans. Jap. Soc. Mech. Engrs. 24*, 642 (1958).

4M Madden, A. J., *AIChE Journal 5*, 135 (1959).

5M Oman, R. A., Scheuing, R. A., *J. Aero/Space Sci. 26*, 126 (1959).

6M Schamberg, R., Proc. 1959 Heat Transfer and Fluid Mechanics Inst., p. 1, Stanford Univ. Press, Calif. (1959).

7M Shirokov, M. F., *Soviet Physics-JETP* 34(7), 1029 (1958).

8M Tewfik, O. K., Giedt, W. H., Proc. 1959 Heat Transfer and Fluid Mechanics Inst., p. 15, Stanford Univ. Press, Calif. (1959).

### Measurement Techniques

1N Aagard, R. L., *Rev. Sci. Instr. 29*, 1011 (1958).

2N Allsopp, H. L., Gibbs, D. F., *Journal Sci. Instr. 35*, 395 (1958).

3N Armstrong, G. T., Wong, P. K., Krieger, L. A., *Rev. Sci. Instr. 30*, 339 (1959).

4N Baumeister, P., *J. Optical Soc. Amer. 48*, 953 (1958).

5N Blum, M. A., *Rev. Sci. Instr.* 30, 251 (1959).

6N Carmichael, C. M., Misener, A. D., *Can. J. Phys.* 37, 890 (1959).

7N Funk, J. P., *Journal Sci. Instr. 36*, 267 (1959).

8N Gavreau, V., Calaora, A., *Ann. des Telecomm. 13*, 153 (1958).

9N Hall, J. A., Leaver, V. M., *Journal Sci. Instr. 36*, 183 (1959).

10N Hall, J. G., Hertzberg, A., *Jet Propulsion 28*, 719 (1958).

11N Hayasi, N., *J. Phys. Soc. Japan 14*, 360 (1959).

12N Jones, D. A., *Rev. Sci. Instr. 30*, 577 (1959).

13N Kemp, J. F., *Journal Sci. Instr. 36*, 77 (1959).

14N Krause, L. N., Johnson, R. C., Glawe, G. E., Natl. Advisory Comm. Aeronaut., Tech. Note *4384* (1958).

15N LaRocca, A., Zissis, G., *Rev. Sci. Instr.* 30, 200 (1959).

16N Laurmann, J. A., *Phys. of Fluids 1*, 469 (1958).

17N Loeffler, H. J., Henrici, H., *Chemie-Ing. Tech. 30*, 708 (1958).

18N Moeller, C. E., *Instr. and Control Systems* 32, 895 (1959).

19N Monteith, J. L., Owen, P. C., *Journal Sci. Instr.* 35, 443 (1958).

20N Monteith, J. L., Ibid. *36*, 341 (1959).

21N Petrick, M., Swanson, B. S., *Rev. Sci. Instr. 29*, 1079 (1958).

22N Rietdijk, J. A., Valstar, A., *Appl. Sci. Res. (A)* 7, 251 (1958).

23N Sehr, R. A., *Chem. Eng. Sci. 9*, 145 (1958).

24N Sibulkin, M., *J. Aero/Space Sci. 26*, 458 (1959).

25N Sims, C. T., Gaines, G. B., Jaffee, R. I., *Rev. Sci. Instr.* 30, 112 (1959).

26N Strauss, W. A., Edse, R., Ibid. 30, 258 (1959).

27N Tamagaw, H., Fujita, J., *J. Phys. Soc. Japan 14*, 678 (1959).

28N Wilson, M. R., Hiemens, R. J., *Rev. Sci. Instr. 29*, 949 (1958).

29N Walker, R. E., Ibid. 30, 378 (1959).

### Heat Exchangers

1P Chen, N. H., *Chem. Eng. 65*, 117 (1958).

2P Ibid. *66*, 141 (1959).

3P Cyphers, J. A., Cess, R. D., Somers, E. V., *ASHRAE Journal 1*, 86 (1959).

4P Dusinberre, G. M., *Trans. ASME—J. Heat Transfer 81*, Series C, 61 (1959).

5P Lapin, A., Schuring, W. F., *Indust. Eng. Chem. 51*, 941 (1959).

6P Larson, C. L., *Nuclear Sci Eng. 4*, 607 (1958).

7P Mai, K. I., *Chem. Eng. Prog. 54*, 57 (1958).

8P Ragsdale, R. G., Natl. Aeronaut. Space Adm., Tech. Note *10-9-58E* (1958).

9P Smith, E. C., *Chem. Eng. 65*, 145 (1958).

10P Witzell, O. W., Fontaine, W. E., Papanek, W. J., *ASHRAE Journal 1*, 35 (1959).

### Aircraft, Missiles, and Satellites

1Q Allen, H. J., Eggers, A. J., Jr., Natl. Advisory Comm. Aeronaut. Rept. *1381* (1958).

2Q Dow, N. F., *Astronautics 4*, 28 (1959).

3Q Ellerbrock, H. H., Jr., Livingood, J. N. B., *Trans. ASME—J. Heat Transfer 81*, Series C, 79 (1959).

4Q Lees, L., *Astronautics 4*, 22 (1959).

5Q Mager, A., *J. Aero/Space Sci. 26*, 99 (1959).

6Q Richards, H. T., Natl. Aeronaut. Space Adm. Memo 1-29-59E (1959).

7Q Stephens, E. W., Natl. Aeronaut. Space Adm. Memo 12-15-58L (1959).

### Electric Equipment

1R Eckert, E. R. G., Hartnett, J. P., Irvine, T. F., Jr., Birkebak, R., *Applications and Industry 41*, 5 (1959).

2R Friedman, D., *Trans. AIEE 77*, Part 2, 372 (1958).

3R Provanznik, F., *Elecktrotechnicky Obzor 47*, 184 (1958).

4R Reeves, T. C., *Elec. Mfg. 63*, No. 6, 63 (1959).

### Table 1 Books and Proceedings Published During the Past Year

1 M. Alperin, M. Stern, and H. Wooster, "Vistas in Astronautics," Pergamon Press, New York, 1959.

2 A. I. Brown and S. M. Marco, "Introduction to Heat Transfer," McGraw-Hill Book Company, Inc., New York 2, N. Y. (3rd ed.), 1958.

3 H. S. Carslaw and J. C. Jaeger, "Conduction of Heat in Solids," 2nd ed., Oxford University Press, London, England, 1959.

4 E. R. G. Eckert, "Einführung in den Wärme und Stoffaustausch," 2nd ed., Springer-Verlag, Berlin, West Germany, 1959.

5 E. R. G. Eckert and R. M. Drake, Jr., "Heat and Mass Transfer," McGraw-Hill Book Company, Inc., New York, N. Y., 2nd ed., 1959.

6 Faculté des Sciences de Paris—Année 1956–1957, "Publications Scientifiques et Techniques," Séminaire d' Aérothermique, Paris, France, 1958.

7 N. Fischer and L. C. Mansur, "Conference on Extremely High Temperatures," John Wiley and Sons, Inc., New York, N. Y., 1958.

8 D. A. Frank-Kamenetzki, "Stoff und Wärmeübertragung in der chemischen Kinetik," Springer-Verlag, Berlin, West Germany, 1959.

9 W. Hryniszak, "Heat Exchangers, Applications to Gas Turbines," Academic Press, Inc., New York, N. Y., 1958.

10 Japan 7th National Congress for Applied Mechanics, Proc. Hydrodynamics, Aerodynamics, Hydraulics, and Lubrication, 1958.

11 S. S. Kutateladze, "Basis of the Theory of Heat Exchange," Mashgiz, Moscow-Leningrad, 1957.

12 A. V. Luikov, "Heat and Mass Transfer in the Evaporation Processes," Publication of the Academy of Sciences of SSSR, Moscow, USSR, 1958.

13 A. V. Luikov and J. A. Mikhailov, "Theory of the Transfer of Energy and Mass," Publishing House of the Academy of Science, BSSR, Minsk, USSR, 1959.

14 W. Mialki, "Kernverfahrenstechnik," Springer-Verlag, Berlin, West Germany, 1958.

15 S. S. Penner, "Quantitative Molecular Spectroscopy and Gas Emissivities," Addison-Wesley Publishing Company, Inc., Reading, Mass., and London, England, 1959.

16 H. Schenck, Jr., "Heat-Transfer Engineering," Prentice-Hall, Inc., Englewood Cliffs, N. J., 1959.

17 H. Schlichting, "Grenzschicht-Theorie," 2nd ed., Verlag G. Braun, Karlsruhe, West Germany, 1958.

18 Third U. S. National Congress of Applied Mechanics, Proceedings, ASME, 1958.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

# BRIEFING THE RECORD

## Ductile Sintered Materials

Through an advanced powder-metallurgy technique, aluminum plus boron or rare-earth oxides—a highly useful control material for nuclear reactions—is now available in a pure, homogeneous, and easily workable form. Previously, the addition of even small amounts of these additives so embrittled aluminum as to render the end product virtually unworkable.

Through the Sinterwrought process, developed by the Sintercast Division of Chromalloy Corporation, Yonkers, N. Y., they are alloyed in a product so dense that its physical properties equal or exceed those of a cast and wrought alloy of the same composition. For example, Binal—boron carbide uniformly dispersed in an aluminum matrix—usable as a "burnable poison" to reduce reactivity when starting the nuclear cycle, can be produced in continuous-strip form. This may be wound into coils and cylinders or fabricated into countless other shapes. Relatively inexpensive composites containing oxides of such unusual metals as dysprosium, gadolinium, samarium, europium, or holmium are routinely produced.

Sinterwrought products are sintered and worked composites, consisting of a high-melting phase uniformly dispersed in a metal or alloy matrix. The process is applicable to compositions containing up to about 30 per cent by volume of dispersoid, usually an oxide, carbide, boride, or intermetallic compound.

"Because these composites are produced from elemental metal, alloy, or mixed powders by a solid-state process," explains John L. Ellis, Mem. ASME, Chromalloy vice-president and manager of the Sintercast Division, "extremely close tolerances in composition are possible. Compared to the usual alloying technique, which involves melting and casting, there is virtually no loss of constituents due to volatilization or segregation. Accuracy of the final composition, therefore, depends only on the care in weighing out ingredient powders, permitting high precision, and easily reproducible results."

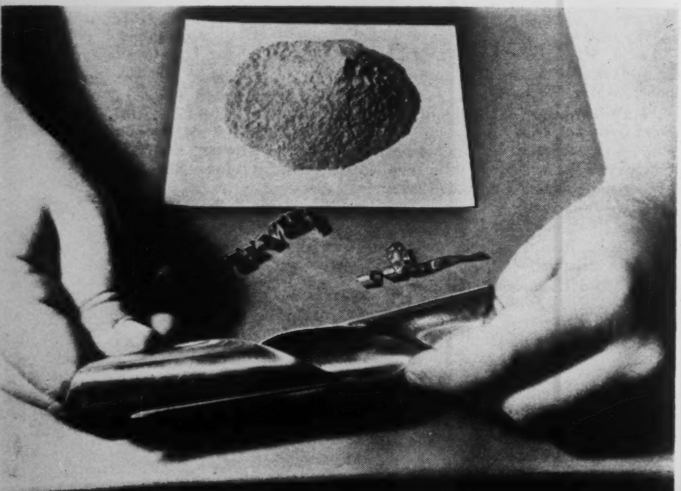
A tolerance of ±0.01 per cent, almost the limit of chemical analysis, may be obtained with a dispersoid content of about 5.0 per cent by volume. Such exactitude in composition, virtually unattainable with standard alloying techniques, is particularly vital where reactor-control materials are involved.

Another advantage is the fact that production by solid-state powder metallurgy guarantees purity of composite. Constituents are never molten, so that there can be no absorption of foreign matter from addition agents, atmosphere, or mold materials. Therefore production of reactor materials with specified neutron-capture cross sections presents no problem.

Of equal interest in nuclear technology is particle size of the neutron-absorbing constituent. Capture of free neutrons, and consequent regulation of the pile, are affected by the spacing, or mean free path, of the dispersoid phase. The advanced-powder-metallurgy techniques employed by Sintercast permit easier regulation of particle size and closer control over microstructure than are possible by conventional melting and casting.

Because mutually insoluble constituents can be combined, alloy compatibility is no longer a problem, allowing the nuclear designer to choose constituents according to his needs. Porosity is also eliminated.

Binal, a sintered boron-aluminum composite produced by an advanced powder-metallurgy technique does not fracture even when it is severely twisted. Ductility is almost as great as that of pure aluminum.



## Organic Compounds and Metal Fatigue

The effects of polar and nonpolar organic compounds on metal fatigue have recently been investigated by the National Bureau of Standards in a program sponsored by the National Aeronautics and Space Administration. The experiments showed that coatings of long-chain polar substances greatly increase the fatigue strengths of steel, magnesium, and copper-beryllium alloys. On metal surfaces the polar compounds apparently form tightly packed monomolecular layers that act as a barrier to water and oxygen molecules. These results are expected to have practical application in extending the useful life of certain metals and alloys.

It is well known that environment influences metal fatigue. Even the mild corrosion that occurs when fatigue tests are run in a laboratory atmosphere may affect test results. A number of studies have shown that certain types of organic compounds afford protection against corrosion under normal unstressed conditions. Because these compounds readily lend themselves to mechanism studies, the present investigation was undertaken to ascertain their effect on fatigue behavior.

Cylindrical specimens were machined in which the longitudinal radius of curvature was held constant at 3.5 in. Minimum diameter of the reduced section was 0.310 in. for magnesium, and 0.250 in. for the other alloys. All of the experiments were conducted on rotating-beam fatigue-testing machines of the R. R. Moore type, which apply pure bending moments to the test section. Specimens of six different alloys were tested to fracture under one of the following conditions: (*a*) Cleaned and dry; (*b*) coated with or immersed in an organic substance; (*c*) immersed in water, either in the coated or uncoated condition. The organic substances used in the experiments are shown in the Table.

**Organic Substances Used in the Metal-Fatigue Experiments**

| Substance | Formula | Type |
|---|---|---|
| n-Hexadecane | $CH_3(CH_2)_{14}CH_3$ | Nonpolar |
| Xylene | $C_6H_4(CH_3)_2$ | " |
| Benzene | $C_6H_6$ | " |
| Octyl alcohol | $CH_3(CH_2)_6CH_2OH$ | Polar |
| Dodecyl alcohol | $CH_3(CH_2)_{11}OH$ | " |
| Dodecylamine | $CH_3(CH_2)_{11}NH_2$ | " |
| Octadecylamine | $CH_3(CH_2)_{17}NH_2$ | " |

The water and nonpolar liquids either had no significant effect or caused a decrease in the fatigue life of the specimens. The polar organic compounds, however, caused an increase of over 600 per cent in the fatigue life of the magnesium alloy, stressed at 12,500 psi; an increase of approximately 250 per cent in the copper-beryllium alloy, stressed at 50,000 psi; and an increase of approximately 200 per cent in the steel alloy, stressed at 100,000 psi. These compounds had little, if any, beneficial effect on the other three alloys—titanium, aluminum, and stainless steel—probably because of the strongly adherent oxide films that form on these materials.

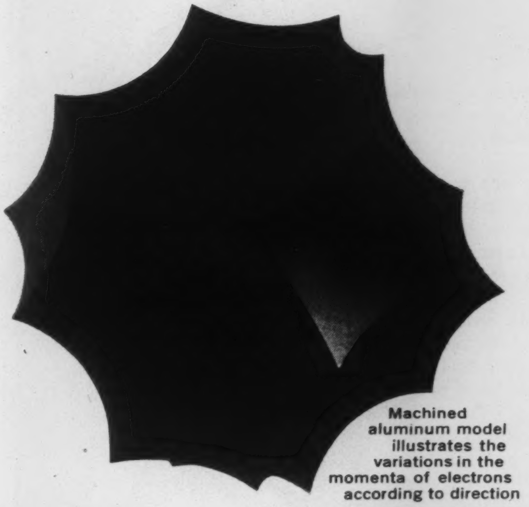
The results showed no appreciable difference between the specimens that were immersed in the polar substances and those that were merely coated with them. Coating the specimens with one of the substances, dodecyl alcohol, and then testing in a tap-water environment resulted in as much improvement as had been obtained with specimens tested in air.

Compounds having chain lengths of 8, 12, and 18 carbon atoms were studied. Of these substances, those having 12-carbon chains apparently gave optimum conditions. The comparison also showed that the type of polar group does not appear to be as important as the number of carbon atoms in each molecule.

## Conduction-Electron Momentum

The ways in which the momentum of a conduction electron varies as it travels through a metal are illustrated by means of a model that has been developed at the General Electric Research Laboratory. The machined aluminum model, with 14 concave faces, serves as a physical representation of the hypothetical "Fermi surface."

As electrons move through the latticework of atoms, their momenta vary according to the direction they take. From one metal to another, the momenta vary depending upon the number of atoms per unit volume and the number of conduction electrons per atom. In the model, developed by physicist B. W. Roberts, these variations are represented by the varying distances from the center to the surface.

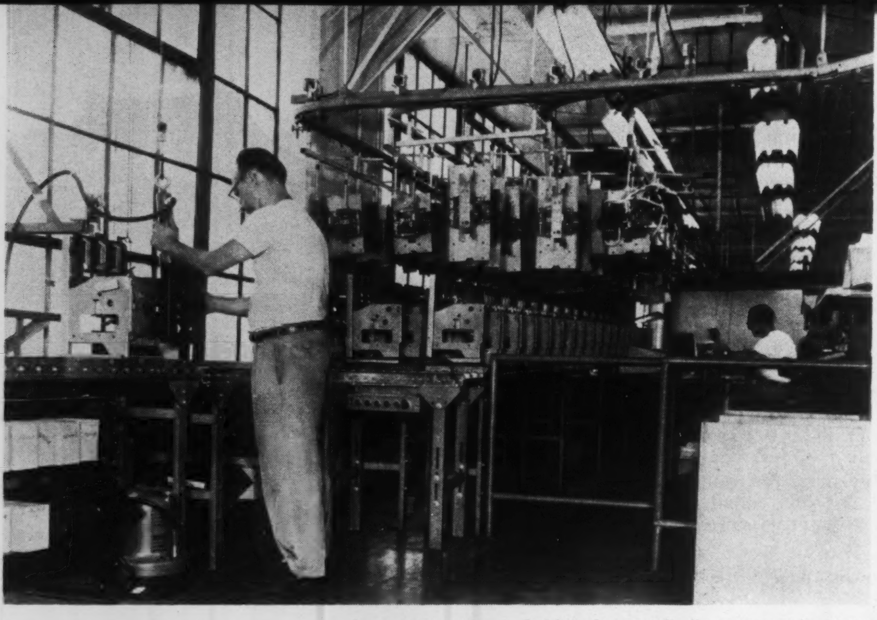

Machined aluminum model illustrates the variations in the momenta of electrons according to direction

The model, and the theory upon which it is based, may lead to a better understanding of the electronic properties of metals, including such phenomena as the deHaas-van Alphen effect, cyclotron resonance, anomalous resistance, and magnetoresistance properties.

Roberts designed the model in the course of studying the electronic properties of metals. In his experiments, he cools a wafer of metal to less than 10 K, and sends sound waves into it, at a frequency of about 70 megacycles. He then measures the attenuation of the waves as they interact with the conduction electrons. By varying the orientation of the metal single crystal, he obtains a measure of how the momenta of the electrons vary with their direction of motion. A magnetic field, applied at right angles to the incoming sound waves, controls the direction in which the electrons move.

Most of Dr. Robert's work has been on aluminum and copper; he is currently investigating zinc and magnesium, and plans work on cadmium and gallium. The metal must be highly purified, with not more than a few parts per million of impurities. The experiment was suggested by theoretical studies conducted over the past several years by Walter A. Harrison, of the Research Laboratory, and his co-workers.

The 14-face model, constructed by sending sound waves—**q** on the diagram—into a metal sample in which their direction of movement is controlled by magnetic field **H**



In-process parts are fed into free gravity lines to permit storage of parts between work stations during assembly operations

## Power-and-Free Conveyer Combination

An intricate power-and-free overhead-conveyer system has solved an in-process storage problem that knotted materials handling at I. T. E. Circuit Breaker Company, Philadelphia, Pa.

This large electronic-components manufacturer needed a system which would permit storage of circuit breakers between work stations during assembly, and could be operator-controlled. The problem was compounded by the limited floor space in the critical assembly area.

A unique 800-ft power-and-free overhead system, engineered and installed by Chainveyor Corporation, simplified parts handling in the assembly area. Adjacent to a power system, with standard Chainveyor components, is a second Chainveyor track exactly the same size as the power track, accommodating free-trolley assemblies. The motivating power line moves carriers from one area to another, while the related free system, on which the carriers actually move, is used for switching and in-process storage.

At I. T. E., eight separate gravity storage lines, controlled electrically by push-button control panel, carry subassemblies through work stations to permanent storage. These free lines were designed with escapement stops on 10-ft centers, which are opened each time a drive log on the adjacent powered lines passes. Free travel is thereby safely controlled to 10-ft stop-and-go movement.

From start to finish, the system operates smoothly. At the load station, a worker places two partially assembled circuit breakers (total load weight, 50 to 60 lb) on a 30-in. carrier. The operator at the push-button control station then directs the loaded carrier into any one of the eight open gravity lines which flow through the assembly cycle. While in storage, parts are readily available, and re-entry into the powered system from free gravity lines may be made at any desired time. Maximum load safety is maintained throughout the operation because of the controlled momentum of Chainveyor's stop-and-go movement.

The success of this system suggests unlimited applications for power-and-free combinations where controlled storage is desired and space is scarce. In initial installation of power overhead conveyer, Chainveyor reports that an adjacent free line is a relatively low cost addition. In effect, such combinations multiply materials-handling capabilities in the same space.

## Artificial Metals and Alloys

Metals and alloys having structures that probably never existed before are being created by a new process disclosed by California Institute of Technology. The structures are expected to increase the range of properties and usability of metals.

The new metals are believed to be much stronger than conventional ones and may have interesting electrical and magnetic properties. New superconductive alloys may be synthesized.

The work under the direction of Pol Duwez, professor of mechanical engineering, is supported by the U. S. Atomic Energy Commission and the Office of Naval Research.

Although the process limits the production of abnormal alloys to small bits of thin foil, there are many applications of small quantities of materials in electronics and other fields.

The technique involves cooling molten droplets of alloys at the unprecedented rate of 2,000,000 deg F per sec. This is accomplished by blasting the hot droplets from a shock-tube gun, containing a crucible and heating unit, against the inside rim of a refrigerated metal wheel spinning at high speed. Gas pressure is built up in the shock tube to the point at which it bursts through a plastic diaphragm. The explosively released pressure wave blasts the molten droplet about $^{1}/_{4}$ in. out of the shock tube's nose onto the copper inner rim. The droplet hits the heat-absorbing copper with a velocity of nearly 300 mph. The impact spreads it quickly into a very thin layer some 20,000 atoms thick and perhaps a half inch in area.

The foil is held firmly against the copper by a centrifugal force of 6000 *g* from the spinning wheel. The wheel is cooled to 314 F by being partly immersed in liquid nitrogen.

The fact that the foil is spread so thin by the heavy impact and held so tightly against the copper makes for a very effective contact between the foil and the heat-absorbing copper. Thus the heat is extracted much more rapidly than normal, preventing the foil's atoms from aligning themselves into their usual patterns and halting the growth of the normal metallic grains.

The procedure is informally known as "splat cooling."

In their molten state, atoms of various metals mix well. Ultrarapid cooling quick-freezes this mixture and does not give the atoms time to realign themselves into normal patterns as they do in the usual, slow cooling process. Also, a metal of much finer grain structure is produced. The individual grains, too small to be seen in an optical microscope, should increase the strength of the foil markedly.

Dr. Duwez explained that the dual purpose of the research was the synthesis of new alloys for insight into theory and the creation of new alloys having unusual properties. The applications are still unknown.

The unorthodox metals also may have improved semiconductivity, leading to new types of transistor devices. Magnetic properties may be enhanced. Electrical resistance and corrosion resistance may be greatly modified.

So far, the investigators have created four abnormal alloys. The first was copper and silver which normally refuse to share individual crystals or grains. That is, the alloy consists of a grain of copper atoms joined to a grain of silver atoms, and so forth. Splat cooling forces the atoms of silver and of copper to unite in a single grain, and the grain size, detectable through standard x-ray diffraction techniques, is much smaller than normal.

Germanium and silver, which also normally alloy in different grains, have been splat cooled into single grains of alloy. The same also is true of gallium antimonide and germanium, both of which are semiconductors.

While the first three abnormal alloys remained stable after cooling, a fourth, gold-silicon, proved to be unstable. X-ray diffraction examination immediately after formation showed its atoms had been frozen in a random distribution like that of glass. Examination 24 hours later disclosed that, after the alloy had cooled, its atoms had rearranged themselves into an unknown complex pattern which may have unusual properties.

## Automatic Inspection of Forgings

Inspection, which until recently was lagging behind fabrication in the application of automatic techniques, has acquired another automatic operation. The RCA electronic-gaging system has been applied to the dimensional checking of axle-shaft forgings.

Employing standard "off-the-shelf" gaging modules, the machine, made by the Industrial and Automation Division of the Radio Corporation of America, checks the shaft for run-out (three places) and out-of-roundness (two places) as well as OD and length.

The flange is inspected for thickness (360 deg) and run-out in reference to the shaft.

Operating at speeds of up to 600 parts an hour, the axles are automatically classified as acceptable or reject, the latter in six categories. Sizes handled range from 28 to 33 in. in length, and 6 to 8 in. in flange diameter.

## Thermoelectric Experimental Kit

Marketing of an experimental kit, especially designed for the study of basic thermoelectric principles, has been announced by General Thermoelectric Corporation, Princeton, N. J.

The basic unit in the experimental kit is a thermoelectric module known as a Frigistor, consisting of eight thermocouples fabricated from Neelium, a new semiconductor material. The module can be used in modifying existing products or designing new devices centered around thermoelectric heating or cooling.

Neelium is the first quaternary semiconductor alloy to be used in the fabrication of thermocouples. It consists of bismuth, tellurium, selenium, and antimony. To date, only binary and ternary alloys have been commercially available domestically.

The experimental kit contains all of the necessary tools for thermoelectric cooling experimentation, including: An F8, Frigistor module; two fin assemblies, one for use at the hot junction for heat dissipation, the other suitable for mounting transistors which require cooling; a single Neelium thermocouple, Model F2; a special heat-conductive adhesive; a special insulating material; a suitable power supply; and a guide for use in calculating hot and cold-junction temperatures and heat-pumping capacities.

Thermoelectricity, a means of producing thermal energy from electrical power with no moving parts, is applicable to a wide variety of cooling and heating functions in electronics, food, and chemical processing, as well as in the basic commercial fields of air conditioning and heating for homes, buildings, and automobiles.

The thermoelectric module, designated as Model F8, measures less than 1 × 1 × $^{1}/_{4}$ in. For connection to the power supply, $3^{1}/_{2}$-in. lead lengths are attached.

A low-voltage power supply, which will drive one or more modules, has been designed for the package.

An eight-thermocouple Frigistor made of Neelium—a new semiconductor material—not only will cool solid-state devices, but a handful of the units, shown enlarged, would provide ample refrigeration for a standard home unit

An electron-beam floating-zone apparatus produced in modular units is used for purifying, joining, and single-crystal growing of refractory metals and ceramics

## Electron-Beam Zone Refining

HIGH-PURITY single-crystal rods up to 9 in. long of refractory metals such as molybdenum, tungsten, tantalum, vanadium, and columbium are produced with an electron-beam zone refiner developed by Materials Research Corporation, MRC, Yonkers, N. Y., and commercially available. With high purity, these ordinarily brittle metals gain in ductility and can be fabricated at room temperature.

To purify them, they must be converted to the molten state at temperatures from 3500 to 6500 F. The inductive heating used in zone-refining apparatus developed by others (MECHANICAL ENGINEERING, October, 1957, pp. 954–955) and in MRC's own line of eight inductive-heated models is replaced in the Model EBZ-93 with an electron beam. This overcomes the temperature limitations of about 2000 F for inductive heating and gets into the refractory range. Even ceramics are being refined.

The electrons are accelerated to high velocity, then bombarded in concentration at a thin zone of the specimen rod. Once melted, the zone travels up the rod with corresponding movement of the electron gun. Purification is achieved by vaporizing most impurity elements in the high vacuum of the melting chamber and concentrating less volatile impurities in the liquid zone which is swept to the end of the rod and cut off.

A patented automatic program drive controls the speed and number of passes and turns the machine off when the run is ended.

The source of electrons is a tungsten emitter enclosed in a specially designed scanner with beam-focusing device. With the stream of electrons concentrated at an extremely narrow zone, it is possible to reach quickly the high temperatures required to melt refractory metals.

The problem metals which have been barred from many potential electronics and satellite applications by their brittleness are now available in ductile form for laboratory study in sizes well above the former "whiskers." They are also being fabricated into small parts which lend themselves to hairpin bending and welding of dissimilar metals which can even be bent around the joint.

## Ultrahigh Pressures for Production Use

ULTRAHIGH pressures are possible on a commercial production basis with a machine announced by F. H. McGraw & Company, engineers and constructors, and developed by a scientific research subsidiary, Engineering Supervision Company, under the direction of Alexander Zeitlin, Mem. ASME. Temperatures of 5000 F and pressures of 1.5 million psi can be applied to large configurations of metallic and nonmetallic materials.

Similar devices producing ultrahigh pressures and temperatures have previously been confined to comparatively small cavities primarily useful only for research.

## Flexi-Core Transformers

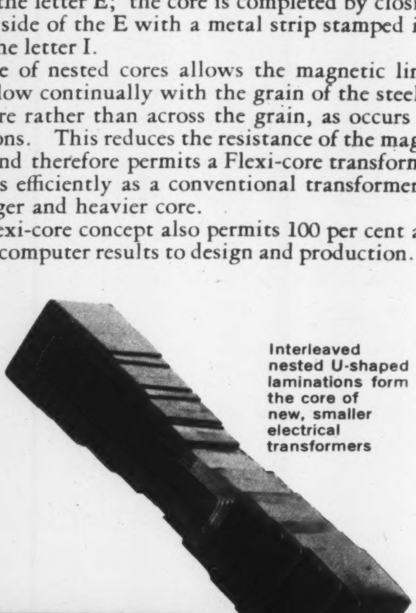
AN ELECTRICAL transformer smaller and lighter than conventional types with identical operating characteristics has been introduced by Sylvania Electric Products Inc., Ipswich, Mass. Described as "a fundamental new concept in transformer design," it ranges from 2 to 30 per cent smaller and lighter than types now in use, depending upon the electrical characteristics required.

It provides a "tailored" transformer in sizes up to 18 × 18 × 36 in. that will fit into equipment and systems already designed rather than requiring adaptation of the design to accommodate transformers of standard shapes and sizes.

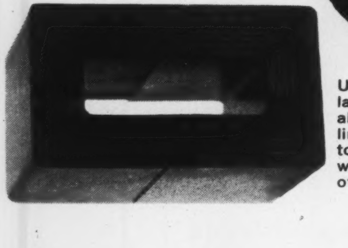
A formed core consists of nests of laminations or layers of fabricated steel strips from a continuous roll. Each of these cores consists of two U-shaped nests of strips; two nests are fitted together, with the strips at the top of the U's interleaved or meshed. The resulting unit is a hollow rectangle, square, or other shape. A so-called core type of transformer utilizes one of these hollow units; in a shell-type transformer two of these units are placed together so that a center post is formed. The core of the conventional, more complex EI transformer consists of laminations of metal stamped in the shape of the letter E; the core is completed by closing in the open side of the E with a metal strip stamped in the form of the letter I.

The use of nested cores allows the magnetic lines of force to flow continually with the grain of the steel used in the core rather than across the grain, as occurs in EI laminations. This reduces the resistance of the magnetic circuit, and therefore permits a Flexi-core transformer to operate as efficiently as a conventional transformer that has a larger and heavier core.

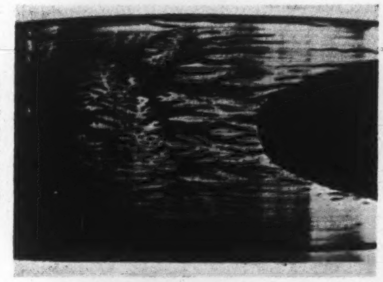
The Flexi-core concept also permits 100 per cent application of computer results to design and production.



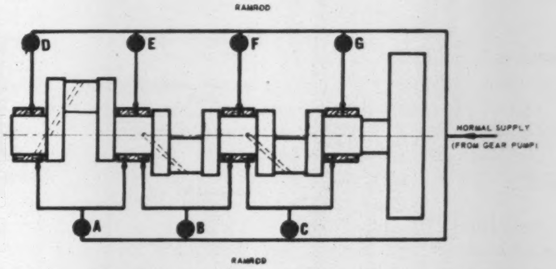
Interleaved nested U-shaped laminations form the core of new, smaller electrical transformers



Use of nested laminations allows magnetic lines of force to flow continually with the grain of the steel



Cavitation begins in the oil film of a bearing at the point where load is applied



Seven Glacier Ramrod pumps supply a volume injection of oil to clear cavitation at the appropriate points in the bearing load cycles. A newly constituted oil film is supplied just before the points of high load in the cycle. This was found more satisfactory than merely filling in the vacant areas caused by cavitation.

## Timed Oil Injection

To overcome the serious effects when engine bearing load is applied where the oil film is disrupted by cavitation, the Glacier Metal Company, Ltd., London, England, has developed a system called Ramrod. Demonstrated at the Waldorf-Astoria Hotel and still in the laboratory stage, Ramrod insures the supply of a complete newly constituted oil film to the main or connecting-rod bearings just before the points of high load in their cycles. This was found more satisfactory than merely filling in the vacant areas caused by cavitation.

In most connecting-rod bearings this is done just before the firing load, although in some very high speed engines the inertia loads give the greater bearing loads. The important points in main bearings depend on the type and design of the engine.

The oil is injected into each bearing by a constant-displacement reciprocating pump—one for each bearing. This is driven at camshaft speed for a four-stroke engine and at crankshaft speed for a two-stroke engine. The Ramrod pumps are arranged as part of the normal lubrication system in such a way that they do not hinder the normal oil flow when they are not themselves operating. The Ramrod injection is thus superimposed on the normal oil system. The connecting-rod bearings are fed through the mains in the conventional way and, if other auxiliary feeds such as piston-cooling supply are involved, they are not interfered with. The Ramrod pumps may be designed as a unit and driven from the end of the requisite shaft or in small engines from additional cams on the engine-valve camshaft.

Ramrod lubrication can be supplied to the main bearings where necessary to deal with the firing and certain inertia loads in their lower halves, and with other inertia loads on their upper halves, and to the connecting-rod bearings to deal with firing loads. In the 3-cyl engine illustrated, three pumps—A, B, and C—supply the injections of oil to the connecting-rod bearings via their respective main bearings, just prior to their firing loads. At the same time, of course, they deal with the effect of the same firing loads on the adjacent main bearings. Four pumps D, E, F, and G inject oil into the top halves of the main bearings to deal with inertia loads near top dead center in the associated cylinders.

The Ramrod pumps themselves are relatively simple units. Precise metering of oil quantity and precise timing are not necessary. They are very much easier to design and cheaper to make than fuel-injection pumps. They are connected between the normal oil supply and the inlets to the main bearings, with nonreturn arrangements so that when the Ramrod pumps operate the injection volume flows to the bearings, and when their stroke is complete the normal oil supply is reconnected.

The time available for the injection of the calculated volume of oil is inversely proportional to engine speed. Thus the higher the engine speed the higher will be the pressure rise resulting in the Ramrod pump. In most cases the pressure in psi in the Ramrod pump rises to the same order as the engine speed in rpm but does not exceed it. For example, in a large low-speed engine running at 500 rpm the maximum Ramrod pressure is up to 500 psi, and in a small high-speed engine of 5000 rpm the maximum Ramrod pressure is up to 2500 psi.

Since only the required volume of oil is delivered to each bearing, and each Ramrod pump operates only for a short period in the engine cycle, the power absorption of Ramrod is so small that it can be balanced out by the reduction in frictional losses in the bearings.

Elimination of this discontinuity of the oil film permits the use of lower-strength materials and increases the practical range of advanced materials.

The application of Ramrod to present engines would give them longer life and greater reliability. It would permit shorter, lighter engines that would be cheaper per horsepower. This is accomplished in a mechanically simple way at relatively low cost.

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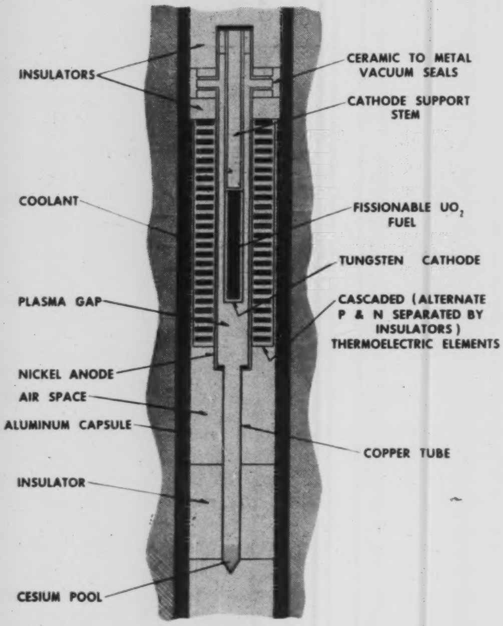
## Wrong Inference

The article on The Geysers Power Plant that was in the June, 1960, issue of Mechanical Engineering was a fine write-up, according to A. W. Bruce, Supervising Mechanical Engineer, Pacific Gas and Electric Company. However, he states there is an error in the first paragraph on page 75. The sentence that is wrong is: "The monel buckets now installed in the 4th to 7th stages will be retained as a protection against mercury. The way it was written by me was: 'The monel buckets now installed in the 4th to 7th stages will be retained as no mercury has been found in the steam, although there are mercury mines several miles away.' "

This means that monel blades could be used because there is no mercury in the steam, Mr. Bruce says. If there had been we would have considered replacing them as there is danger that the mercury would amalgamate with the monel and cause embrittlement.



## Direct Conversion in Fuel Assemblies

Two auxiliary forms of power generation have been combined to convert some of the otherwise wasted heat of fission directly into electricity.

According to William E. Shoupp, Mem. ASME, technical director of the Westinghouse atomic-power department, a thermionic and thermoelectric generator was built into a nuclear fuel assembly and inserted into a reactor to produce electricity.

The experiment, conducted by Peter J. McCoy at the Westinghouse Testing Reactor at Waltz Mill, Pa., produced about 1 watt of power. It was designed to determine the feasibility of such a "dual" generator without consideration of optimum efficiency or high power output. Taking part in the six-month development program leading up to the experiment were G. R. Feaster of the Westinghouse electronic tube division, Elmira, N. Y., and scientists of the research laboratories near Pittsburgh, Pa.

Dr. Shoupp said there are significant inherent power losses in today's nuclear-powered generating stations, caused by the large temperature drop from the center of the fuel elements to the outside surfaces in contact with the cooling water. While some fuel elements themselves reach temperatures above 4000 F in the fission process, he explained, it has only been possible to get about 600 F out of the fuel elements and into the surrounding water. This limits the amount of heat which can be taken from the fuel.

To use the heat energy at the higher temperatures, a fuel element was built with the thermionic generator in its center and a thermoelectric generator surrounding it. Both methods of converting heat directly to electricity operate on similar principles, but operate most efficiently at widely divergent temperatures. A thermionic generator operates at about 3500 F, but will not function efficiently at temperatures below 2700 F. A thermoelectric unit, on the other hand, does not operate at such elevated temperatures, but works well in the temperature range of 600 to 1800 F.

By putting the two types of generators in tandem, the heat passing through the thermionic generator flows through the thermoelectric unit. The elements are wired in series to give a combined electrical output over a very wide temperature range.

Joseph C. Danko, manager of direct-conversion activities at the atomic-power department, said: "While this experiment was just to determine feasibility of the heat conversion system, the development program will continue toward the goal of increasing the efficiency of the device."

## Progress on Coal-Fired Gas Turbine

A recent report by James P. McGee and Richard C. Corey, Mem. ASME, of the Bureau of Mines, summarizes research objectives for the coal-fired gas turbine which was turned over to the Bureau last year by the Locomotive Development Committee of Bituminous Coal Research, Inc. (Mechanical Engineering, May, 1959, p. 78).

Availability comparable to that of modern steam turbines is regarded as the most important requirement for a coal-fired gas turbine—about 50,000-hr availability is the ultimate objective. To accomplish this, means must be found to minimize the adverse effects of the mineral matter in the coal on the performance characteristics and the frequency of forced outages.

Possible solutions being considered include: (*a*) Reducing the concentration or particle size of solids in the products of combustion to the point where the erosive effects on the blades will be negligible; (*b*) redesigning blades and gas paths to minimize the effects of gas-borne solids; (*c*) evaluating the possible corrosive effect of mineral matter in the coal.

The Bureau of Mines is studying improved methods of ash separation, considering changes in combustor design, and devising test methods that will provide accurate mass and heat balance for each component of the unit.

The Gas Turbine Division of the General Electric Company is co-operating in a critical study of the aerodynamics of the turbine with respect to the distribution of gas-borne solids and will use these studies as the basis of recommendations for improved blade design.

## Fuel-Cell Power Pack

A portable power supply representing one of the first practical military applications of fuel cells is being developed by General Electric and undergoing evaluation testing.

Producing 200 watts of 24-volt d-c for 14 hr, the 30-lb power pack can be carried easily by one man and will take the place of a 55-lb engine generator or 80 lb of secondary batteries. If operated continuously over longer periods of time, it requires only additional increments of fuel. For example, to provide full power at a remote site for a week, only 72 lb of fuel would be needed. This is opposed to transporting almost a half ton of freshly charged batteries to the site.

The power pack is designed to operate at full load for a minimum of 2000 hr without maintenance.

There will be a series of 30 ion-membrane fuel cells each 11 in. sq and approximately $^{1}/_{4}$ in. thick.

## Analog-Digital Differential Analyzer

The National Bureau of Standards has been investigating a proposed analog-digital differential analyzer[1] that combines the analog advantages of high speed and continuous representation of variables with the digital capability for high precision and dynamic range. It represents dependent variables by two quantities, a digital number representing the more significant part, and an analog electrical voltage representing the less significant part.

Developed by H. K. Skramstad of the NBS data-processing-systems laboratory, the proposed analyzer appears to be naturally applicable in simulating the dynamic problems in missile or aircraft-design studies. The addition of short digital registers and other digital components to an analog computer provides the increased precision required for solving such problems, while retaining the speed of the analog computer.

The electronic analog computer, although useful in solving dynamic problems described by differential equations, suffers from limitations of accuracy and dynamic range. The digital differential analyzer can provide any required degree of accuracy or dynamic range, but it can be relatively slow in operation and subject to possible instability of solution resulting from numerical representation of the variables and the use of finite differential calculus in integration. Using both analog and digital techniques in a single analyzer makes it possible to combine the advantages of each for solving problems rapidly and with the desired level of precision.

It is estimated that with present components the precision in solving problems can be increased by a factor of 10 to 100 over conventional analog methods.

Under the sponsorship of the Bureau of Naval Weapons, work has recently begun on the construction of breadboard models to evaluate the system. These circuits will contain two integrator and two multiplier units, each capable of receiving input voltages from other units. Digital registers and digital-to-analog converters will be constructed from transistorized digital packages, and the analog components from commercially available wide-band operational amplifiers. These units will have eight-bit-plus-sign input and accumulating registers, and an analog reference voltage of 10 volts. They will operate with a $\Delta t$ of 1 millisec or less.

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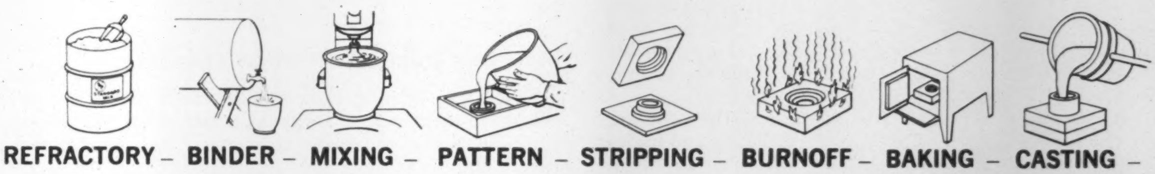
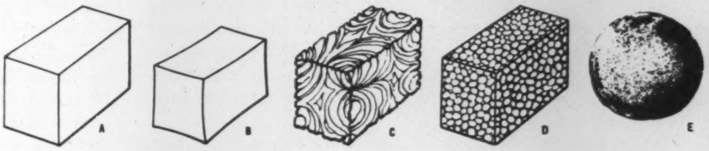
[1] Further technical information is given in "A Combined Analog-Digital Differential Analyzer," by H. K. Skramstad, Proceedings, Eastern Joint Computer Conference, 1959.


REFRACTORY – BINDER – MIXING – PATTERN – STRIPPING – BURNOFF – BAKING – CASTING –

The sequence of process operations, **upper row,** in a unique metal-casting process which utilizes "microcrazing" to accommodate expansion. By accelerating conchoidal fracture **C,** structure shown in photomicrograph **E** is formed.



## Ceramic-Mold Casting Technique

A unique metal-casting process produces large metallic products with higher strength and closer dimensional tolerances. It has been demonstrated by Shaw Process Development Corporation, Port Washington, N. Y., a division of British Industries Corporation, and was originally developed in England in 1938. Called the Shaw Process, it produces sound sections, smooth surface, close-tolerance dimensions, and complex shapes without lengthy machining techniques.

Castings can be made of any metal—from brass or bronze up to and including stainless steel and the high-temperature alloys used in gas-turbine and missile construction—in small or large quantities.

The unique advantages stem from an unusual ceramic material used in the production of the mold which produces "microcrazing," a three-dimensional effect which has the appearance of wire netting under the microscope. This consists of minute fissures or air gaps which are small enough to prevent molten metal from entering into them, but large enough to accommodate the expansion of the individual ceramic or refractory particles when heated by the molten metal. Even more important, these fissures are just the right size to allow air and gases to escape—thus avoiding porosity, cracks, surface inclusions, and other bugaboos of conventional foundry operations.

Metal castings produced in Shaw molds are said to have better surfaces and sounder sections because of the elimination of gas "pickup" from the mold. This results from the controlled "craze cracks" which allow the venting of air trapped by the metal stream. An economic advantage resulting from this phenomenon is that molds can be designed without a great many of the massive "risers" which are characteristic of conventional molds.

From the design engineer's point of view, the greater intricacy of detail obtained in the final product is an important advantage. This results from the characteristic of "strippability," due to the rubbery nature of the jelled ceramic-mold mass. Still another source of benefits in the final metal product is the fact that the unique Shaw mold allows the pouring of hot metal directly into the cold mold—a situation that is unthinkable with any other ceramic body. This advantage in turn stems from the "breathing" of the mold particles, which gives the mold complete resistance to thermal shock, and virtually zero coefficient of expansion.

An octagonally shaped compressor station in this ultramodern municipal gas plant makes possible a very short radial transmission of gas to and from the compressors

## Automatic Gas Plant

The Long Beach, Calif., Municipal Gas Department has installed a $2.5-million ultramodern, fully automatic facility to tie into the present expanding distributing system.

Designed and engineered by M. A. Nishkian & Company, the plant features a huge Wiggins-type gas holder and an octagonally shaped compressor station.

Contrary to conventional in-line-designed plants, the unusual octagonal design encircles a 10-ft-diam sphere for gas suction, and has a doughnut-type ring header encircling the sphere for gas discharge making possible a short radial transmission of gas to and from the compressors.

Automation advancements are especially prominent at the unique plant, where central recording and indicating instruments are contained on a complete wall panel. Observed by a single operator seated at a modern console, he can, through use of pneumatic-type apparatus, operate the entire plant automatically. Even valves or groups of valves located miles away throughout the city's distribution system can be remotely operated from this same master control panel.

The giant gas holder, an outstanding achievement in heavy construction, built by General American Transportation Corporation, rises 17 stories and has a capacity of 5 million cu ft of gas.

## Operation Pig Squeal

In a move akin to "getting the last squeal from the pig," a group formed by Cities Service, Atlantic Refining, Tidewater Oil, and Continental Oil has purchased a large dry-adsorption system from Delta Tank Manufacturing Company for the recovery from natural gas of gasoline and "bottled-gas" products such as propane and butane. Some 175 million cu ft a day of offshore natural gas are expected to yield as much as 400 bbl of natural gasoline, plus separate streams of butane and propane totaling 600 bbl, without appreciably shrinking the stream of natural gas that will flow to domestic and industrial consumers.

Placed in operation at Grand Cheniere, La., early this year, the big unit consists of eight 20-ft-high towers. Four towers contain some 60,000 lb of a new grade of pelletized activated carbon made from selected petroleum products by National Carbon Company, Division of Union Carbide Corporation. Activated carbon is particularly efficient in trapping the lighter petroleum products such as propane and butanes. The other four towers will contain silica gel and activated carbon for the adsorption of the heavier natural-gasoline fractions (pentanes, hexanes, heptanes, and heavier). Natural gasoline is used primarily as a motor fuel stock; the liquefiable petroleum gases, LPG, and their components are used to control gasoline vapor pressure, as "bottled-gas" fuel, and as a raw material for petrochemical plants.

## Machines Duplicate Human Thinking

Machines can now control other machines, predict the weather, memorize all the knowledge of the world, compose music, translate languages, send rockets into space, and solve in a few seconds problems on which mathematicians could spend a whole lifetime.

The equivalent of the human memory could be embodied on a piece of glass 5 × 6 in. at the present state of computer development. The electric circuits would be stenciled on the glass by putting a diagrammatic mask over it and depositing a fine film of metal. The film would serve as a pattern of electric wires. This spider's-web circuit can be frozen at about −270 C—the temperature at which helium gas liquefies (liquid helium is used as the refrigerant) and certain metals become superconductive.

Furthermore, experts attending the first International Conference on Information Processing as reported in the Proceedings just published by UNESCO foresaw, within a matter of years, electronic devices which will memorize all the knowledge in the world—the British Museum, the Bibliothèque Nationale, the Library of Congress, and indeed, all the recorded facts of the Occident and the Orient, past and present.

With all its circuits, valves, and gadgets, 15 years ago the electronic computer was in principle just an ultra-high-speed abacus, capable of doing complicated sums in split seconds. Today this device has developed to the point where Edward Teller could claim that not only could it count and memorize but that it could become teachable, acquire experience, form judgments, develop emotions, and take initiative. "I believe that the machine can be given the power to make value judgments as well as logical reasoning, and from that I can construct, mathematically, a model for machine-emotion . . . When you come down to it, what is the difference between machine-thinking and our own thinking? We cannot draw the line. Any human process which is logical can be copied by the machine."

This prospect was not at all reassuring to some electronic experts. Bernard Benson, an American designer and manufacturer, warned the conference that the machine has only as much integrity and honesty as the information that is put into it by human beings. People were not only fallible but sometimes deliberately so. This was exceedingly dangerous because the gigantic memories which they were discussing would contain a great deal of information—much of it about people.

## Saving Almost 2 Million Btu per Hr

A SAVING of almost 2 million Btu per hr is expected by American Cyanamid Company, Bound Brook, N. J., with the installation of a new Fin-Pak heat exchanger manufactured by The Air Preheater Corporation, Wellsville, N. Y.

The heat exchanger, which uses the recuperative principle of heat recovery, is expected to capture and utilize close to 2 million Btu per hr which were formerly wasted in the atmosphere. As the exhaust gas passes through the unit, metal fins with an exposed surface of almost 6000 sq ft trap the heat and conduct it through a separating wall into the path of incoming air. The fins extending into the flow passage of cool air preheat the incoming air before its entry into the superheater.

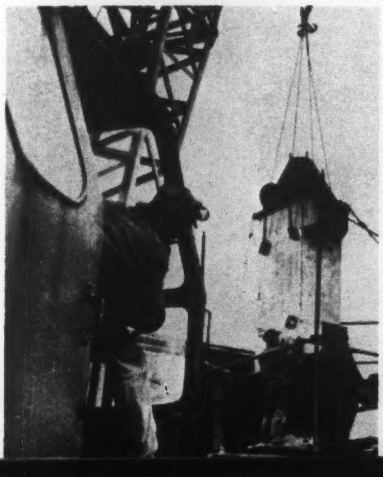
The cool air is drawn into the system by a compressor, and after passing through the heat exchanger is fed into the superheater to support combustion of the fuel oil. Since the incoming fresh air arrives in the superheater at a temperature of over 700 F—increased by the preheater from 100 F—there is a substantial reduction in fuel requirements.

The compact (approximately 10 × 5 × 3-ft) heat exchanger, weighing only 13,000 lb, was placed at the base of the exhaust stack. A 25-ft, 16-in-diam stack will be placed above it, thus making the unit a component of the exhaust system.

The exchanger is designed to take 12,000 lb per hr of air at 100 F and 16,000 lb per hr of gas at 770 F and has a rated air-side effectiveness of 92.2 per cent. With an inlet pressure of 19.7 psia for air and 14.7 for gas, the pressure drops are 9.4 in. water gage on the air side and 2.6 in. water gage on the gas side.

The Bound Brook plant of American Cyanamid is part of the Organic Chemical Division which manufactures organic chemicals used primarily by the textile, rubber, and mining industries. The Fin-Pak heat exchanger is part of a process making diphenylamine, an intermediate in the manufacture of rubber chemicals.

The recuperative principle of heat recovery will be used in this new heat exchanger

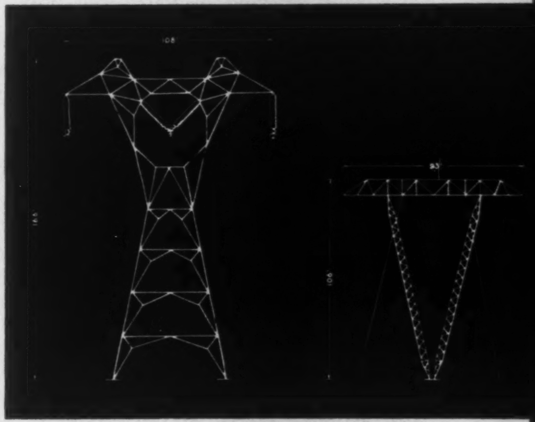


## EHV Tower Designs

ALUMINIUM, LTD., of Canada, and Commonwealth Associates have completed design of towers they were preparing for the Extra-High Voltage Project. Alcan, a new co-operator, brings the number of companies associated with General Electric in this research project to twelve, according to the June 1 *Electric Light and Power*.

Alcan's aluminum tower (slated to be No. 8 in the project) will be guyed and V-shaped. Masts will be 101 ft long and the crossarm, 98 ft above the ground, will be 93 ft long. The guyed 4500-lb Alcan tower will be fabricated by Michael Flynn Manufacturing Company of Philadelphia, Pa. Commonwealth Associates, Inc., has designed steel towers 10 and 17. Tower 10, one of the two highest structures in project EHV, will be 166 ft tall for a 2200-ft span across the Housatonic River, while tower 17 will have a more representative height of 123 ft. The narrow-base, minimum-weight steel towers will be fabricated by the American Bridge Division of United States Steel Corporation.

**Left,** high steel tower designed by Commonwealth Associates; **right,** V-shaped aluminum tower designed by Aluminium, Ltd., of Canada



## Handling Cryogenic Materials

CRYOGENIC fluids—extremely cold and generally liquefied gases—are used increasingly for a variety of engineering purposes. According to an article in the *Industrial Bulletin* of Arthur D. Little, Inc., the commonly used cryogens are helium, hydrogen, nitrogen, fluorine, oxygen, and methane. They boil at atmospheric pressure in the range of −452 to −258.5 F.

These fluids attain a high density when liquefied. They can be easily stored at only a few atmospheres of pressure, and it is economical to ship them in this dense form. For example, liquid methane has been transported across the Atlantic in a specially designed tanker. Large quantities of oxygen have been stored and transported as liquid for use in steel production. Liquid oxygen is now the most common oxidant used in missile propellant systems. Liquid hydrogen is expected to be the fuel for future U. S. space probes, and liquid fluorine is under careful study as an oxidant. Liquid nitrogen is used as a refrigerant to improve the performance of infrared and electronic detecting systems, and liquid helium provides a low-temperature environment for basic research into the structure of matter and high-performance electronic components, such as computer elements and crystals for infrared detectors.

Cryogens are not only dangerous to handle because of their low temperatures, but liquid oxygen and fluorine are especially hazardous because of their strong oxidizing properties. Most organics and many metals will burn in their presence, possibly with explosive violence. Even a light hammer blow directed against certain materials saturated with liquid oxygen is often enough to initiate a detonation. Fluorine is extremely toxic and corrosive, requiring special venting systems and materials of construction. Hydrogen has very wide flammability limits, and will explode if ignited in air in an enclosed space. Many materials of construction, particularly carbon steel, become as brittle as glass. Thus it is necessary to use materials such as copper, aluminum, or stainless steel to avoid the hazard of catastrophic failures caused by brittle fracture of apparatus containing cryogens.

Since the amount of heat per pound required to vaporize cryogens at atmospheric pressure is only $^1/_5$ to $^1/_{100}$ that required to vaporize water, even small amounts of heat will evaporate substantial quantities. The storage vessel must be well insulated and provision made for venting, recondensing, or refrigerating the cryogen. One kind of cryogenic container is similar to a thermos bottle, with double walls enclosing an evacuated space. Alternatively, the space can be filled with a low-thermal-conductivity powder to achieve the same insulating qualities with less stringent vacuum requirements. Improved insulations, with still lower thermal conductivity, are being developed. One type uses layers of aluminum-foil and fibrous-glass separators. The entire sandwich is evacuated.

The transfer of cryogens from storage to the place of use is accomplished with centrifugal pumps or pressurized gas, either separately or in combination. In present-day ballistic missiles, liquid oxygen in the missile oxidant tank is delivered to the combustion chambers at pressures that range from 300 to 750 psi. These pressures are usually obtained in a single-stage centrifugal pump driven by gas turbines. The space that remains in the tank as the oxidant is removed is kept under 2 or 3 atm pressure. In missile ground-support facilities, liquid oxygen may be transferred by using either gaseous oxygen or nitrogen to pressurize the storage tank. In gas-pressurized transfer, either the gaseous form of the cryogen being transferred or lower-boiling-point gases which do not react with the cryogen are used.

Great care must be taken in operating storage vessels or transfer systems to prevent contamination. Even inert elements, such as water or nitrogen, which are solid at the temperature of liquid hydrogen, can cause damage to mechanical equipment, such as valves, by acting like dirt particles. Oxygen "freezes" in the presence of liquid hydrogen, and under certain conditions the two can react with explosive violence. One method for removing contaminating gases is to evacuate the system and then flush it out with a pure inert gas or with the gaseous form of the liquid to be stored. Gas analyzers are often used to sample the atmosphere at various points in the system, to guard against re-entry of contaminants after the cryogen has been introduced. Many other techniques have had to be developed to permit the handling of liquefied gases in quantity; cryogenic engineering is an art in itself.

## Nuclear Briefs

### ▶ Nuclear Gasification of Coal

James P. McGee and Sidney Katell of the U. S. Bureau of Mines recently reported preliminary calculations which show an economic advantage in using nuclear heat to gasify coal, according to the June, 1960, *Forum Memo* of the Atomic Industrial Forum.

Their conceptual design calls for producing the process heat with three 250-tmw slightly enriched, gas-cooled reactors and passing the helium coolant through an exchanger-type gasifier where coal and steam would be reacted to form carbon monoxide and hydrogen.

A system of this size, according to their calculations, would use 311,000 lb per hr of a low-quality coal to produce 14 million cu ft per hr of carbon-monoxide hydrogen mixture which could be further processed to produce 90 million cu ft per day of high-Btu gas.

In order to test the feasibility of the proposed system, the Bureau of Mines has constructed a high-temperature helium loop at its Morgantown, West Va., Coal-Research Center to test components such as heat exchangers, recycle compressors, and valves.

### ▶ Nuclear Weather Detector

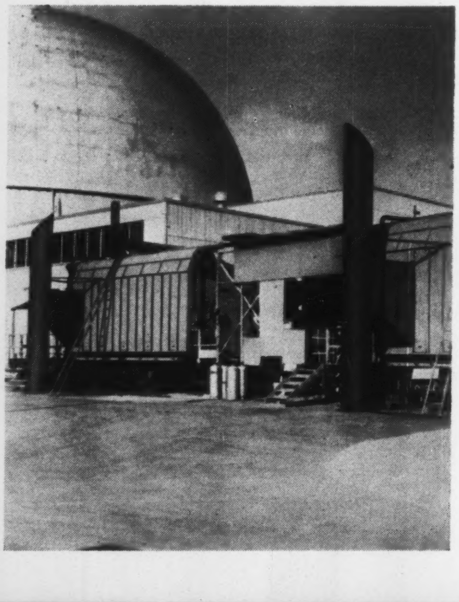
Tracerlab, Inc., has been awarded a contract by the AEC's Office of Isotope Development to develop a nuclear weather detector for the U. S. Weather Bureau, according to the June, 1960, *Forum Memo* of the Atomic Industrial Forum.

The company said that operation of the device will be based on the ozone in the earth's atmosphere reacting with a radioactive clathrate (a crystalline substance inside of which is trapped radioactive krypton 85) to release a proportional amount of radioactive krypton 85, which in turn will be measured by a built-in Geiger tube. One meteorological theory, according to the company, holds that weather patterns can be more readily predicted with increased information on the size, flow, and location of ozone clouds caused by solar radiation in the earth's atmosphere.

### ▶ Flatcar-Mounted Steam Generators Used in Testing

In the preliminary testing prior to the activation of Commonwealth Edison Company's 180,000-kw Dresden

Preliminary checking of the Dresden Nuclear Power Station's steam lines was made with conventional packaged steam generators mounted on flatcars



Nuclear Power Station, the steam lines had to be checked and the turbine balanced prior to the start-up of the entire Nuclear Reactor System. This was accomplished quickly and economically with two Keeler Type-DK Package Steam Generators. These were arranged on location to simulate the eventual pattern of nuclear operation.

Two 55,000-lb-per-hr Keeler DK units were fired-up five days after their arrival at the job site—without removing them from the railroad flatcars on which they had traveled from the E. Keeler Company plant in Williamsport, Pa. Fuel oil was piped directly to the burners through temporary underground lines from nearby tankcars. The steam generators were installed in the summer of 1959 and removed from the job site in January, 1960.

The two package steam generators were operated at capacities up to 68,000 lb per hr for considerable periods in the preliminary checking and later final testing of the plant's steam system, and in the balancing of the turbine.

### ▶ KEWB Reaches 2,300,000-Tkw Peak Power

The Kinetic Experiment on Water Boilers, KEWB, a nuclear research reactor operated by Atomics International at Canoga Park, Calif., for the AEC, has reached a power peak of 2,300,000 tkw after installation of a new core vessel.

KEWB is a 50-kw homogeneous reactor for safety studies fueled with a solution of U-235.

Quick surges of energy are produced to investigate basic mechanisms and the inherent shutdown behavior o the reactor during abnormal operating conditions. The pulse reactor can also be used for determing the effects of intense momentary radiation on biological systems and electronic equipment.

The new core enables the reactor to more than triple its previous pulsed thermal-power output which totaled 650,000 kw.

With the new core, KEWB delivers 90 per cent of the energy of a maximum power surge in just 0.005 sec. During power bursts, the KEWB reactor produces more than 100,000 tkw per quart of fissionable fuel. The reactor automatically shuts itself off after the power surges without sustaining damage.

The Kinetic Experiment on Water Boilers is a pulse experiment which has reached a 2,300-000-tkw peak

Plastic caps on common steel bolts that do not pop off when tighented are corrosion resistant

## Materials Briefs

### ▶ Plastic-Capped Bolts Resist Corrosion

Bolts are being capped with a durable and corrosion-resistant plastic to extend their usable life under high-rust or chemically corrosive conditions.

The capping method was developed by Clear-Cite Products of Chicago, Ill., specialists in plastic coatings and moldings. It uses Kralastic MM, a new acrylonitrile butadiene styrene copolymer, developed by the Naugatuck Chemical Division, United States Rubber Co., which is designed to resist cold flow under loads. This property prevents the cap from popping off under the high-torque squeezing action which occurs when the bolts are tightened.

Millions of the plastic-capped bolts are already in production for an application where highly corrosive juices are generated. Cost is about half that of bolts capped with stainless steel.

### ▶ Synthetic-Mica "Paper"

A method of forming tiny flakes of synthetic mica into paper-thin sheets that may prove superior to natural mica for certain uses in electronics has been discovered by the Bureau of Mines at Norris, Tenn., under an accelerated research program sponsored by the General Services Administration.

Further work to reduce the mica paper's tendency to absorb water in storage and to improve its properties is being undertaken by the Bureau and General Telephone and Electronic Laboratories, Inc., of Flushing, N. Y.

Strength and flexibility, high dielectric strength, and better retention of properties than natural mica are characteristic.

The synthetic-mica flakes are obtained by crystallizing a melted mixture of feldspar, sand, magnesia, lithium fluoride, and other minerals.

### ▶ Fernico-5 Matches Thermal Expansion of Alumina

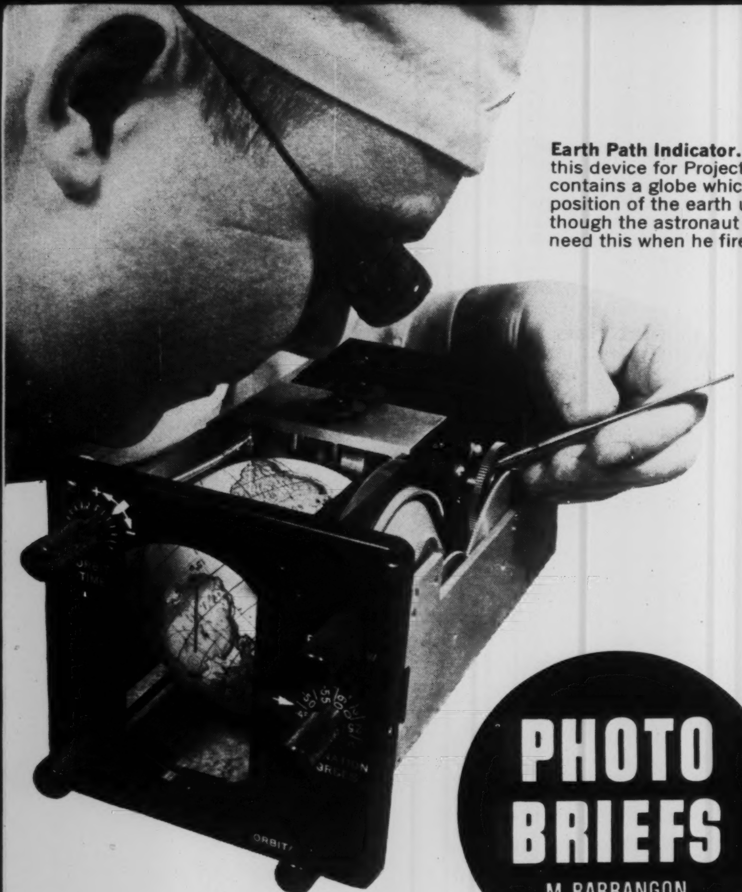
A new alloy, "Fernico-5," which closely matches the thermal expansion of alumina has been announced by General Electric Research Laboratory.

The thermal expansion of alumina, the ceramic that possesses probably the best combination of properties for general use in the electric industry, is much lower than that of the metals and alloys normally used in metal-to-ceramic seals. For this reason it has not been possible to take full advantage of its high strength, high heat resistance, and excellent insulating properties.

Fernico-5 combines iron, nickel, and cobalt in a unique ratio. The desired, low thermal expansion of Fernico-5 is achieved by optimizing the ferromagnetic properties in this iron-base alloy. Vacuum melting is used to control oxygen levels and expansion characteristics without addition of other elements, such as manganese or silicon.

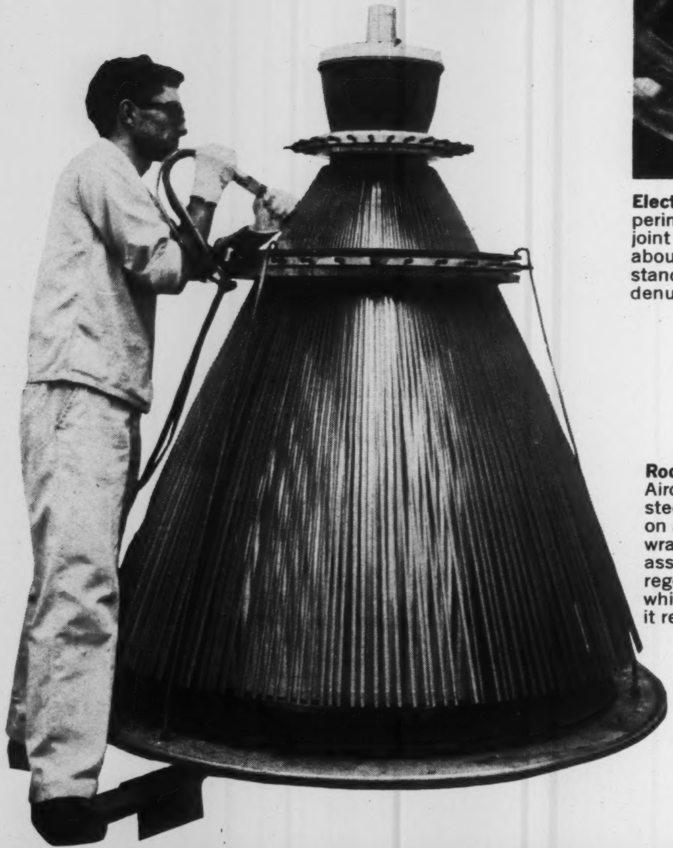
# PHOTO BRIEFS

M. BARRANGON



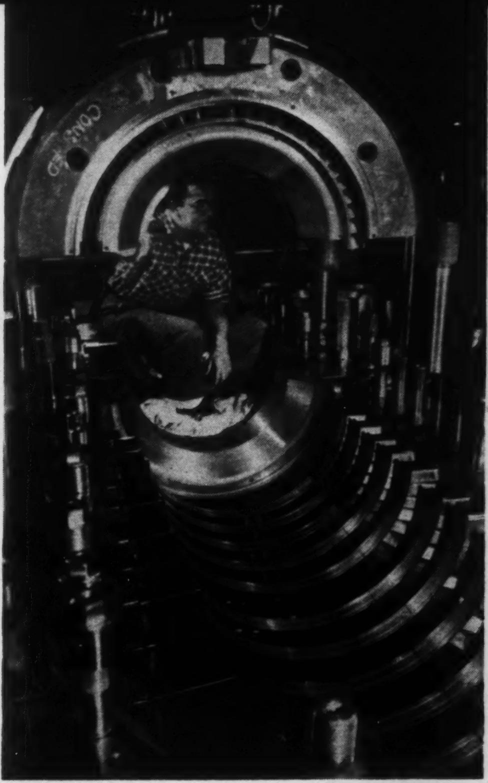
**Earth Path Indicator.** Minneapolis-Honeywell developed this device for Project Mercury. The indicator contains a globe which revolves slowly to duplicate the position of the earth under the orbiting capsule, as though the astronaut were actually seeing the earth. He'll need this when he fires the rockets that bring him back.

**Electron Welding.** At Republic Aviation, an experiment with a new welding process—the weld-joint area bombarded with electrons to generate about 6000 F. The goal: Welded joints to withstand 3000 F in such space-age metals as molybdenum alloy and pure tungsten.

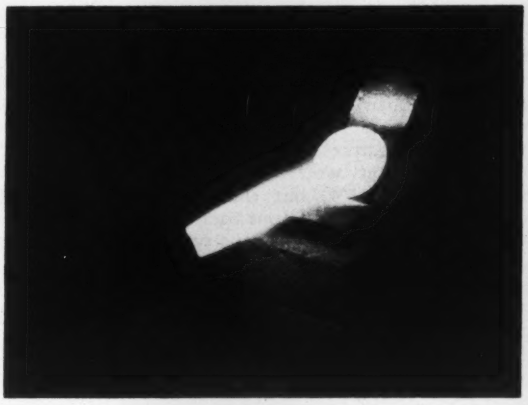


**Rocket Thrust Chamber.** At Solar Aircraft, U-shaped strips of stainless steel (AM-350, by Allegheny Ludlum) laid on a mandrel and welded, will later be wrapped with ribbon of the same steel. The assembly is then brazed, forming a regeneratively cooled thrust chamber in which fuel flows in the channels before it reaches the injector.

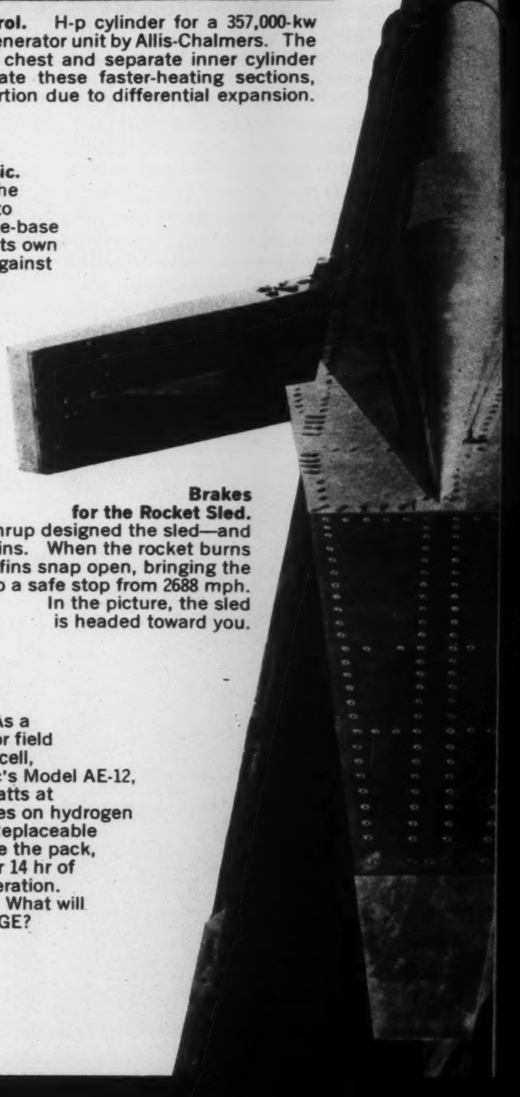
**Beading Pyrex Pipe.** Corning Glass has developed equipment for on-the-job cutting and beading of Pyrex Brand piping and "lifetime drainlines." The outfit is supplied in a special kit and can be quickly set up for fabricating nonstandard lengths.



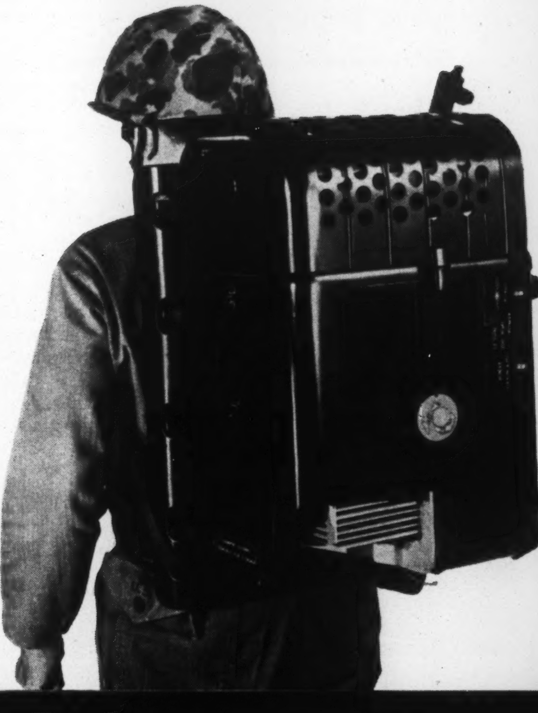
**Expansion Control.** H-p cylinder for a 357,000-kw steam turbine-generator unit by Allis-Chalmers. The ring-type nozzle chest and separate inner cylinder blade rings isolate these faster-heating sections, preventing distortion due to differential expansion.



**Self-Coating Ceramic.** Boeing sponsored the research which led to this ceramic graphite-base material. It forms its own protective coating against heat and oxidation, for ultrahigh-speed flight.



**Brakes for the Rocket Sled.** Northrup designed the sled—and the braking fins. When the rocket burns out, the fins snap open, bringing the sled to a safe stop from 2688 mph. In the picture, the sled is headed toward you.



**Fuel-Cell Power Pack.** As a power source for field radar, this fuel cell, General Electric's Model AE-12, produces 200 watts at 24 volts, operates on hydrogen and oxygen. Replaceable canisters, inside the pack, produce fuel for 14 hr of unattended operation. Weight: 30 lb. What will the GI think of GE?

# EUROPEAN SURVEY

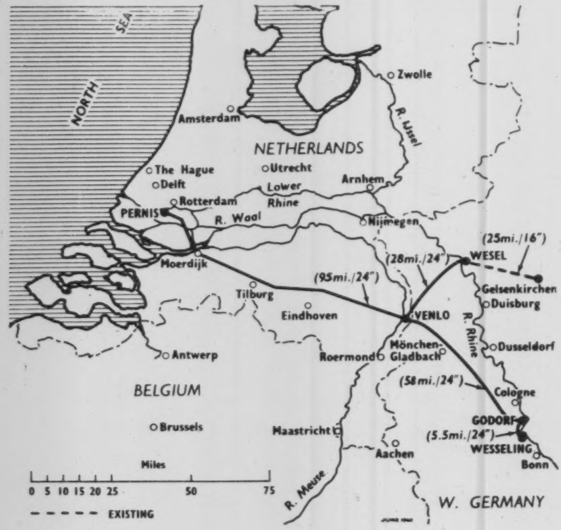
Engineering
Progress in the
British Isles and
Western Europe

J. FOSTER PETREE
European
Correspondent

## Rotterdam-Rhine Oil Pipeline

In the "European Survey" for June, 1959, mention was made of the oil pipeline then under construction from Rotterdam to the German refineries in Western Germany, about 185 miles up the Rhine—the first international crude oil line in Western Europe. Part of it was then in use, but the complete system is now in operation. It was formally inaugurated June 27, 1960, in a ceremony at Venlo, near the Dutch-German border, by Mr. H. J. Slingenberg, joint managing director of the owning company, the N. V. Rotterdam-Rijn Pijpleiding Maatschappij. This is a joint undertaking, 40 per cent of the shares being held by the Royal Dutch/Shell Group, 40 per cent by the Gelsenberg und Mobil Oil Handels Gesellschaft, and 20 per cent by the California Texas Oil Corporation. The line has cost nearly $30 million to build and can transport $8^1/_2$ million tons of crude oil a year. When an additional pumping plant is installed, it is expected to handle 20 million tons. From Pernis, near Rotterdam, it runs 95 miles to Venlo and there divides, one branch of $63^1/_2$ miles serving the Shell refinery at Godorf (which will take 4 million tons a year), and the Caltex plant at Wesseling, near Cologne. The other branch runs 28 miles to Wesel, where it connects with an existing 16-in. line to Gelsenberg.

Oil pipeline being constructed from Rotterdam to West Germany.



## Sectional World Power Conference

The plenary meetings of the World Power Conference are held at intervals of six year—the next will be in 1962, in Melbourne, Australia—but in between these major events it is the practice to hold sectional meetings in different countries, at which attention is devoted to a comparatively limited field or theme. This year's Sectional Conference, held in Spain from June 5 to 9, with headquarters in Madrid, dealt with "Methods for Solving Power Shortage Problems" and drew a record attendance of 1356 participants from more than 50 countries, who contributed 164 papers to the 14 sections into which the broad subject was divided. It was a heavy program to compress into $3^1/_2$ working days (for the technical sessions were held only on June 6–8 and the morning of June 9) but the reporters who had predigested the papers had done their work well and most of the speakers in the discussions were commendably brief and to the point in their remarks.

There was some disappointment, though, when it was realized that the visits to places of technical interest in the neighborhood of Madrid—to various works, the Nuclear Energy Center, hydroelectric plants, and so on—were arranged to run concurrently with the technical sessions. Another couple of days would have eased the situation considerably, for there was also the usual generous provision of official and private receptions and similar gatherings to be fitted somehow into the timetable.

The proceedings began with a formal meeting on June 5 at which the delegates were officially welcomed by the Spanish Government, the Corporation of Madrid, and the Spanish National Committee of the World Power Conference. Addresses were presented by representatives of various participating nations, including the United States and Great Britain, and the United Nations Economic Commission for Europe; and a message was read from Sir Harold Hartley, Honorary Chairman of the International Executive Council. Dr. F. Holzinger, President of the World Power Conference, emphasized, in a short address, the need to "accelerate to the maximum the economic promotion of the underdeveloped regions," as well as the responsibility resting upon engineers and scientists in bringing this about. Somewhat similar in plan, but rather less formal, was the closing session in the afternoon of June 9, at which Sir Vincent de Ferranti (G.B.) presided.

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Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton Surrey, England.

After the closing session the delegates and other participants, with their 744 "accompanying persons," dispersed; many of them on the six "study tours," radiating from Madrid, which were admirably arranged to provide them with a general impression of the technical as well as the scenic resources of the country. As Sir Christopher Hinton, the British Government's official representative at the Conference, said at the opening meeting, the developments achieved in Spain in both industry and agriculture within the past ten years have been remarkable.

## Gas From the Sahara?

WHILE for the most part the contributions to the Madrid World Power Conference dealt with current progress in conventional means of power production and distribution, an interesting indication of possible future developments with natural gas was given by Mons. Georges Combet, President of the French National Committee.

Four years ago, he said, there was a feeling of insecurity among the OEEC countries regarding the possibility of meeting the increasing demand for power, but already the outputs expected then for both gas and nuclear energy in 1960 had been surpassed. He predicted that in another three years supplies of natural gas from the Sahara would be arriving in Europe. A project was now in hand to lay an 8-in. gas main across the Mediterranean from North Africa, though the route to be followed had not yet been settled; it might be near Gibraltar, or through Italy, or across to France from Algeria. The capital investment involved would be about $700 million.

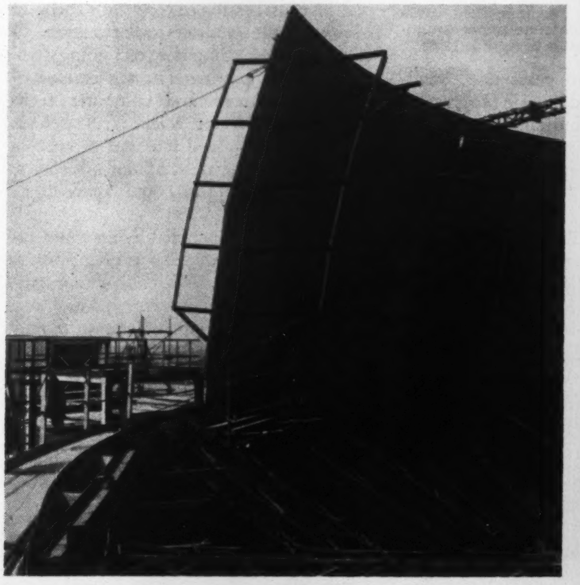
## Advanced Gas-Cooled Reactor

AT WINDSCALE, in Cumberland, England, not far from the original plutonium-producing reactor which "ran away" three years ago and had to be permanently sealed off, the new experimental advanced gas-cooled reactor of the United Kingdom Atomic Energy Authority is now rapidly taking shape. The power-producing atomic plants at Calder Hall and Chapelcross, which are in regular use feeding electricity into the national grid, have fuel elements of natural uranium enclosed in cans of magnesium alloy, but this combination is limited to an output of about 2.5 mw per ton of uranium and a can surface temperature (which controls the temperature of the $CO_2$ gas coolant) of 450 C. The new type of reactor will use uranium oxide fuel instead of metallic uranium, with cans of either beryllium or stainless steel, enabling the coolant temperature to be raised to 500–575 C and the output or "fuel rating" to 19.5 mw per ton—six times that of the Calder Hall type. By this means it will be possible to raise the net efficiency of the station to 38 per cent, compared with the 25 to 30 per cent of the Calder Hall type, giving half again as much electrical output for the same reactor heat output.

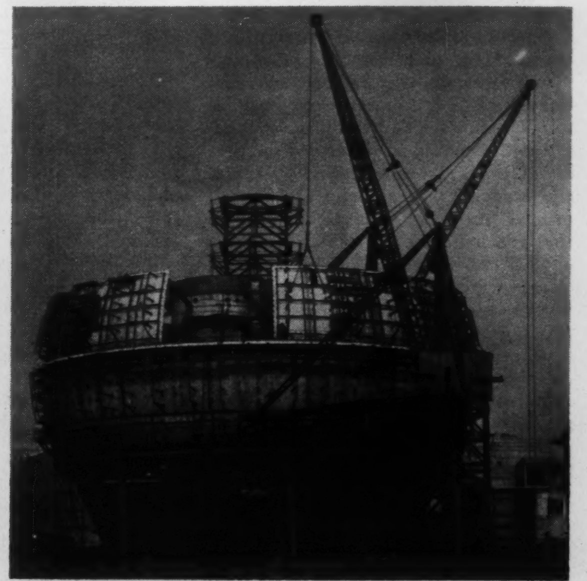
The reactor vessel is of aluminum-killed grain-controlled mild steel, having an internal diameter of 21 ft, a height of 53 ft 6 in., and a weight of 250 tons. It is contained in a steel shell 135 ft diam, spherical in form for about two thirds of its height, with the lowest third in the form of an inverted cone. It weighs 850 tons and is made of steel panels, pressed into shape at the works of the contractors (Babcock & Wilcox Ltd.) and welded together at the site. All welds are radiographed. The base of the conical portion is 70 ft diam. There are four heat exchangers, 67 ft 9 in. high and 11 ft in diam, and four centrifugal gas circulators, driven at 3000 rpm by squirrel-cage induction motors of 1570 hp. The 33-mw turboalternator will run at 3000 rpm, delivering 11.5 kv current at 50 cycles. The pressure at the turbine stop will be 650 psig.

Eighty per cent of the fuel elements will be contained in beryllium cans and 20 per cent in stainless-steel cans. Spent fuel elements will be removed and new ones inserted by a refueling machine that weighs 400 tons and stands 60 ft high. The graphite core of the reactor, consisting of 3000 closely fitting graphite blocks, weighs 210 tons. The $CO_2$ coolant is circulated at the rate of about 20 tons per minute. It is expected that construction will be completed in April, 1961, and that the plant will be giving its full output by October, 1961.

A detailed view showing the method of supporting the preformed steel plates during fabrication by Babcock & Wilcox Limited of the welded steel containment building for Advanced Gas-Cooled Reactor of the United Kingdom Atomic Energy Authority at Windscale, Cumberland



The advanced gas-cooled reactor being built at Windscale. The ultimate objective is to gain operating experience of carbon-dioxide-cooled, graphite moderated power reactor using a different type of fuel canning material than at Calder Hall and at a higher temperature.



Substance in
Brief of Papers
Presented at
ASME Meetings

# ASME TECHNICAL DIGEST

## Aviation

**Convertiplanes in Commercial Operation ..60—Av-4...**By D. E. Postle, The Kaman Aircraft Corporation, Bloomfield, Conn. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

The short-haul market offers the greatest potential yet to be developed in the air-transportation industry. Basic requirements of short-haul transportation and the aircraft flight characteristics necessary in this field are considered.

The offering to the public of short-haul scheduled air-transport service should include the following essential features in order to generate high-volume passenger travel and profitable load factors: (*a*) Direct city-center to city-center operation; (*b*) convenient locations within cities for the arrival and departure; and (*c*) punctuality of schedules.

Flight characteristics necessary for an aircraft to perform successfully in short-haul operations are: (*a*) Ability to land and take-off vertically; (*b*) complete instrument capability, full anti-icing provisions, and multiengine power with adequate performance in the case of failure of one power unit; and (*c*) adequate net payload capability under all operating situations coupled with a reasonably high cruising speed—a minimum of 175 mph.

According to the author, only the Convertiplane can meet these requirements. Only one Convertiplane configuration has proved its value and includes all of the flight characteristics, speed, and economic factors required for commercial transport operation. This is the true helicopter to which has been applied stub wings and additional thrust devices which achieve rotary wing flight with the unloaded rotor principle. Of this type, the Fairey Rotodyne has been developed and flight-tested to insure its commercial success. Details of this plane, and its advantages in the field of passenger and cargo carrying, are presented.

**Fixed Wing STOL Aircraft With Distributed Suction BLC for Extended Latitude.. 60—Av-12...**By J. J. Cornish, III, Mississippi State University, State College, Miss. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

The fundamentals and details of applying boundary-layer control by means of suction through distributed perforations for the purpose of extending the steep take-off and landing abilities of fixed-wing aircraft are discussed.

Two aircraft, a modified L-21 and a modified L-19, which have been equipped with high-lift systems utilizing distributed suction are examined as typical examples of this class of STOL vehicles.

The performance of these airplanes is analyzed and the effectiveness of this type of high-lift system is compared to other existing high-lift devices such as the single and multislotted flap and systems using other forms of suction and ejection boundary-layer control. In addition, some problems unique to classical aircraft operated at very high lift coefficients are discussed in detail.

**An Advanced Chemically Fueled Power Supply for Space Vehicles..60—Av-29...** By W. E. Wayman and A. W. Mills, Sundstrand Corporation, Pacoima, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Approximately two years ago, Sundstrand Turbo initiated a basic program of investigation into auxiliary power systems for space vehicles. This investigation, encompassing various arrangements of heat sources and static and dynamic conversion apparatus, was organized and executed along the lines of two major work phases: (*a*) Systems synthesis and performance estimation, and (*b*) component research and development.

The extensive investigation resulted in the development of an advanced chemically fueled power supply for space vehicles. The prototype unit, the Model 870, was started, which later became the forerunner of the present Models 871 and 871A currently under test.

The Model 871 power system is a complete, integrated turbine-powered package having accessory outputs over a duty cycle of 4.5 hr with a total life of 100 hr. The gross turbine-wheel output has a maximum rating of approximately 52 hp.

The Model 871A is the final prototype complete with fuel pump and multistart hypergolic ignition system. This advanced prime mover, already operated continuously in excess of 5 hr, has, at the writing of the paper, accumulated over 29 hr without change of components.

Continuing developments have gradually converted these one-time small power-level heat-sink units providing 5 to 10 hp for a few minutes' duration to machines capable of sustaining a full-power output between 50 and 100 hp for a continuous duty cycle of several hours.

**Possibilities for Simulation of Human Dynamics and Perception..60—Av-39...** By A. J. Cacioppo, Goodyear Aircraft Corporation, Akron, Ohio. 1960 ASME Annual Meeting paper (multilithographed; available to April 1, 1961).

A brief discussion of Newton's theorem of similitude and its relationship to contemporary computer technology introduces this paper. The application of similitude theory and computer techniques to behavior science research is demonstrated by a discussion of specific research from the areas of motor-response dynamics, perception, and space-flight applications.

The paper is concluded by an enumeration of possible computer applications to behavior science research. The applications range from intraperson to interperson analysis, and include economic analysis as well as possible applications to problems encountered in international relations, such as the spread of hostile ideologies.

**Accomplishments in Human Simulation..60—Av-26...By A. B. Clymer, Mem. ASME, North American Aviation, Inc., Columbus, Ohio. 1960 ASME Aviation Conference paper (multilithographed: available to April 1, 1961).**

A brief review is given of many significant accomplishments in the simulation of physiological systems, human operators, and higher processes, using physical models and analog and digital computers.

There are two broad classes of simulators:

1 Physical models.
2 Mathematical models embodied in computers.

Simulation by means of a computer is more useful than a physical model since computers are not restricted in the systems they represent. Either the digital computer or the operational analog computer has advantages as a simulator.

Accomplishments in physiology simulation include: (*a*) Cell simulation, (*b*) circulation dynamics simulation, (*c*) neuromuscular system simulation, (*d*) homeostasis simulation, and (*e*) biochemical reaction simulation.

Accomplishments in human operator simulation included are: (*a*) Linear representations of a human operator, and (*b*) computer simulations of a human operator.

Two approaches for the simulation of higher processes are included: (*a*) Neural-net models, and (*b*) problem-solving models.

The review indicates that there has been a vigorous and rapidly accelerating effort in the development of simulations of the human system. Mutual benefits should accrue from more communication among workers in the three areas of effort which have been pursued nearly independently during the past decade.

**Accomplishments in Human Operator Simulation..60—Av-40...By R. L. Cosgriff and G. E. Briggs, The Ohio State University, Columbus, Ohio. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).**

Psychologists today have come to regard certain aspects of human behavior as possessing characteristics not unlike machines. Machine analogs serve the psychologists with a basis for conceptual reference.

Of particular importance in this regard are the machine analogs provided by communication and by feedback-control theory. Theory development in psychology during the past decade has made increasing use of communication and feedback-control concepts especially in those fields of psychology concerned with the interaction of man and machine; e. g., in human engineering and in perceptual-motor skills.

By reference to machine analogs it is possible to conclude that, as a controller, man resembles at times a dual-mode servo and at other times a sampling servo. He is capable, therefore, of changing significantly his control mode. Further, he is a nonlinear controller in that his control mode changes as a function of training and of fatigue, he exhibits transmission discontinuities and exponential lags, and he employs dither on occasion.

The engineer has provided powerful quantitative methods to augment the descriptive capabilities cited. These quantitative methods are, of course, the techniques developed for determining transfer functions for the human operator in control tasks.

These methods and the important insights providing to the understanding of human behavior are considered. A brief review of events leading up to the development of the transfer-function techniques is made with special reference to use of the techniques to explain human behavior in continuous control tasks. Consideration is given to recent research on the development of simulation techniques for the derivation of nonlinear transfer functions.

**Monorail Potential?..60—Av-3...By W. H. T. Holden, Consulting Engineer, Pasadena, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).**

Monorail, which has acquired a special meaning apart from the literal meaning of a railroad running on a single rail, is considered from the historical point of view, and the evolution of the various types known today is traced. Possible types are classified.

The potential of these systems from the standpoint of the vendor and the operating agency is analyzed, and it is concluded that, as a system, monorail has no advantages that will commend its use to an operator, while the age and variety of the prior art is such as to render any exclusive patent position by any vendor today unlikely.

While the airframe industry has developed technology that may be applied to the rail vehicle to the advantage of both the industry and the transit systems of the world, the diversion of these abilities into an exhausted art, monorail, cannot be regarded as a sound management or engineering decision.

**Maintaining American Airlines' Turbojet Engines..60—Av-18...By J. S. Merenski, American Airlines, Inc., Tulsa, Okla. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).**

American Airlines began commercial operation of the Boeing 707 jet transport powered by four Pratt & Whitney JT3C-6 engines in January, 1959. Since then the engine has proved to be one of the finest and easiest to maintain power plants introduced into commercial aviation.

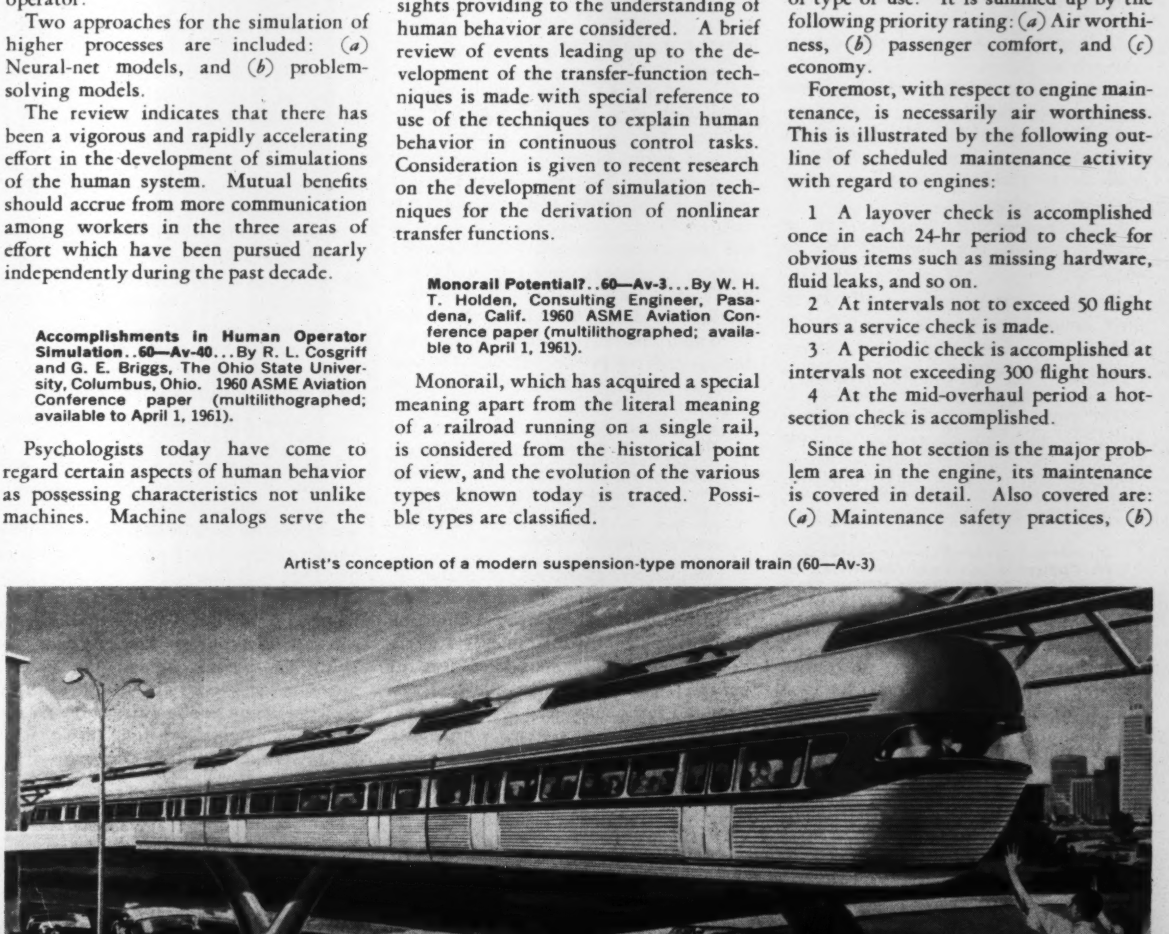
The airlines' basic philosophy of equipment maintenances is the same regardless of type or use. It is summed up by the following priority rating: (*a*) Air worthiness, (*b*) passenger comfort, and (*c*) economy.

Foremost, with respect to engine maintenance, is necessarily air worthiness. This is illustrated by the following outline of scheduled maintenance activity with regard to engines:

1 A layover check is accomplished once in each 24-hr period to check for obvious items such as missing hardware, fluid leaks, and so on.
2 At intervals not to exceed 50 flight hours a service check is made.
3 A periodic check is accomplished at intervals not exceeding 300 flight hours.
4 At the mid-overhaul period a hot-section check is accomplished.

Since the hot section is the major problem area in the engine, its maintenance is covered in detail. Also covered are: (*a*) Maintenance safety practices, (*b*)

Artist's conception of a modern suspension-type monorail train (60—Av-3)



engine reliability, and (*c*) engine overhaul.

Observations of the engine's mechanical integrity made from the detailed investigation of every engine received for overhaul are enumerated.

American Airlines' experience shows that the ease of maintenance is helping make the turbojet engine the most reliable power plant in commercial airline service.

**Maintenance on Pipeline Gas Turbines.. 60—Av-19**...By B. J. Matthews, El Paso Natural Gas Company, El Paso, Texas. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

In 1952, the El Paso Natural Gas Company installed the first of 32 gas turbines as intermediate boosters on its main transmission lines from Texas to California.

The original design choice in favor of the gas-turbine station over the more conventional gas-engine station was made for the following reasons:

1 The gas turbine coupled with the centrifugal compressor offered increased flexibility which would allow the pipeline operator to meet his fluctuating load requirements.

2 The gas turbine offered a higher power package and could be installed at lower cost.

3 Operating costs were expected to be lower with the gas-turbine station than they would be with the conventional reciprocating station.

4 The geographical location of the proposed stations in the arid Southwest made the gas turbine with its low cooling requirements desirable.

5 The gas turbine offered much lower lube-oil consumption than did the gas engine.

At the present time more than 1,000,000 fired hours have been accumulated on these turbines. Reasons why the design choice in favor of the gas turbines was a wise one are shown.

The paper describes the maintenance problems and procedures used by the company and mentions briefly the design problems which were incident with the maintenance problems.

**Distributed Suction Boundary-Layer Control Applied to Axial Fans..60—Av-14**...By E. G. Miles, United States Military Academy, West Point, N. Y. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Suction boundary-layer control through distributed perforations was applied to an axial-flow fan to determine the feasibility of the use of this type BLC to delay the stall and improve the efficiency. A 36-in-diam, three-bladed, axial-flow fan was chosen for this test. The fan was run without perforating the rotor blades.

Data were taken at various resistances to the flow in order to plot performance curves for this constant-speed machine. The rotor blades were perforated for suction BLC, data taken, and new performance curves plotted as before.

The results showed, by the comparison of the two sets of performance curves, that suction BLC did improve the efficiency by 28.5 per cent and did extend the operating range of this fan.

**Simulation Testing of Rocket Engine Control Components..60—Av-24**...By J. R. Fenwick, North American Aviation, Inc., Canoga Park, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

That simulation can be used as a practical and economical approach to the development testing of rocket engine-control components is shown by three examples: (*a*) A thrust-vector control, (*b*) a thrust-magnitude control, and (*c*) an engine-mixture-ratio control.

The use of such testing procedures requires a system simulation (assumed to consist of an analog-computer mechanization), suitable transducers, and a flow bench to supply pneumatic or hydraulic power. It is noted that, at the present time, transducers present the biggest problem area.

The author concludes that closed-loop simulation presents a practical and economical way of testing rocket-engine control components in a closed-loop environment. The extent of the testing which is practical at the present time is limited by the availability and state of the art of transducers which convert voltage to pressure, flow rate, and force.

Programs which have utilized this method for design and checkout are few in number, but the results obtained have been gratifying in both economy of testing and quality of product.

**Mission and State-of-the-Art Effects on Rocket Feed System Comparisons..60—Av-23**...By J. Jortner, Assoc. Mem. ASME, and J. K. Rosemary, North American Aviation, Inc., Canoga Park, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

A liquid-propellant rocket engine requires a feed system to transport propellant from its tank to the combustion chamber. Two distinct and rival methods are commonly considered for the puropse; namely, gas-pressure feed systems and turbopump-feed systems.

The gas-pressure system, which provides pressure in the propellant tanks high enough to force propellant into the combustion chamber, requires relatively large quantities of gas and relatively heavy, high-pressure tanks.

The turbopump system, which uses gas-turbine-driven pumps to feed the thrust chamber, makes more efficient use of gas energy and requires that propellant tanks withstand only relatively low pressures.

Whether the weight of the turbopump will be more than the savings in weight of the tank-and-gas system depends on how long the system is to fire. With a long-firing mission, the turbopump-fed system may be expected to weigh less than the pressure-fed system. Since most rocket applications require what are, by this standard, long-firing durations, pump-fed missile stages of given gross weight usually provide larger payloads than are possible with pressure-fed stages of the same gross weight.

This paper shows how the payload-weight advantage of a turbopump-fed system is affected by the particular mission assigned to the propulsion system and by the state-of-the-art at the time of its construction.

**Moisture Migration in an Aircraft Cabin Wall..60—Av-8**...By F. B. Bjorklund and A. C. Watson, Douglas Aircraft Company, Inc., Santa Monica, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

With the advent of higher altitudes in air travel, a new problem that has confronted the aircraft designer is that of retarding the accumulation of moisture within the walls and on the inside surface of the outer skin and other cold structural surfaces of the airplane.

The ability of a wall configuration to restrict the migration of moisture has, in the past, been very difficult to evaluate, at least until the airplane had been in service many months and the walls were disassembled for some reason. As a result, the moisture accumulated for a long period of time without quantitative knowledge on the part of the airline operator.

Certain problem areas have been tested under accelerated conditions in the laboratory on simulated wall sections, revealing useful information as to optimum vapor barrier design and installation methods.

In order to reduce greatly the time required to analyze a wall configuration, a computer program was set up on the IBM 701 digital computer to predict moisture accumulation in an airplane wall for many configurations under any airplane ambient condition.

This program utilizes the analogy between heat and mass transfer in obtaining its solutions, and results have compared, favorably with laboratory test data. This method of analysis is at least a small step toward the solution of a big problem.

**Moisture Accumulation in Aircraft Soundproofing and Insulation..60—Av-7...**By J. Jensen-Gaard, Maintenance Base Kastrup Airport, Denmark. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

In houses and cold stores one of the means to avoid moisture accumulation in walls and insulation is to apply a watervaportight barrier on the warm side of the insulation.

In a modern aircraft during flight the fuselage skin forms a vapor barrier on the cold side of the insulation. The result is moisture accumulation in the insulation. A proposal for a method to keep an aircraft fuselage insulation and inside structure dry is to:

1 Introduce an aluminum foil on the back side of the cabin lining.

2 Introduce a slight pressure behind the lining by means of air from, for instance, the cold air ducts.

Since the skin temperature on a jet aircraft in flight is several degrees higher than outer air temperature, the dew point of this always will be below the skin temperature, except for short periods during very fast descents, and when outside air humidity is very high.

A description of tests carried out to demonstrate the principle is given.

Installation of a cabin-lining material covered with aluminum foil on the back side, reduction of leakages to a practical minimum by a proper installation, and introduction of a slight pressure in the insulation by drilling a sufficient number of small holes in the air-conditioning ducts are shown to avoid moisture accumulation in aircraft insulation.

**The Development of United Air Lines' Jet Transport Galleys..60—Av-9...**By R. H. Koza and R. L. Heinrich, United Air Lines, San Francisco, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Jet passenger service has increased the need for a functional galley to serve passengers anything from a cup of coffee on a short flight to a full course dinner on a longer flight.

A comprehensive study of the movement of hot foods, cold foods, beverages, and storage equipment—through flight kitchens, the aircraft galley, and to the passengers—was necessary at United Air Lines. The basic design of a galley had to be completed by the time the airframe designers firmed up the length and width of the fuselage so that the total galley space required, the location of the galley in the fuselage, and the size of the galley service required could be established.

The primary requirements for a jet galley included:

1 The design must provide for the efficient use of space and efficient operation under a variety of service configurations. It may be used for beverages, light snacks, a quick one-tray service, or full course service.

2 Identical units may be located in the forward and in the aft cabins but their capacity and function must be adequate to serve the maximum load of first-class passengers or coach passengers.

3 All of the foods, beverages, dishes, trays, and so forth must be assembled in the minimum number of packages which it is possible to handle from a practical standpoint to expedite and simplify the handling in the flight kitchens and the loading or unloading at the airplane.

Tests of individual parts, functional trials of full-scale working models, proved that radical design was warranted.

A description is included of the training required for all personnel involved in the daily handling of a new type of galley and some of the operational experiences.

**The DC-8 Seat—Passenger Protection With Structural Economy..60—Av-10...** By Jack Madsen, Douglas Aircraft Company, Inc., Santa Monica, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

This paper presents the results of an effort on the part of the designer and strength analyst to create a maximum strength seat per pound, with optimum structural dynamic characteristics and safety.

The structural development process of the DC-8 first-class triple seat is offered as an example of a very satisfactory combination of these characteristics. The supplementary device concept, as proposed by Aviation Crash Injury research of Cornell University in attaining maximum safety, is shown adapted to the track-mounted DC-8 seats.

The subject covers the following topics: (*a*) Seat characteristics, (*b*) structural requirements, (*c*) seat structural components, (*d*) analysis and testing.

**The FAA Looks at Flight Controls..60—Av-31...**By E. S. Newberger, Federal Aviation Agency, Washington, D. C. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

The minimum safety standards applicable to civil aircraft and how they are provided for, especially in the more complex power-control systems, are reviewed here.

Covered in the paper are:

1 The civil air regulations.

2 Development of standards as they apply to flight-control systems.

3 Control-system design.

4 Power systems.

5 Rotorcraft.

The author reveals that civil experience with primary-control systems has been excellent. Failures of mechanical primary-control systems are practically unheard of and have not been the cause of any accidents. Secondary-system failures are very infrequent. Service experiences will be carefully evaluated by the FAA, and regulation revisions will be made when experience so dictates.

**The FAA Looks at Jet Transport Mechanisms..60—Av-6...** By H. D. Hoekstra, Transports, FAA, Washington, D. C.; and W. B. Spelman, Transports, FAA, Los Angeles, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

The mechanisms and machinery of U. S. certificated jet transports are broadly surveyed. Aspects of aerodynamics, structures, thermodynamics, and human factors are discussed, but only as they enter into the establishment of design considerations for mechanisms.

For typical mechanisms and machinery and their systems, the regulatory and standards basis for approval, some of the problems of design, FAA tests, and operational experience are outlined.

Particular emphasis is placed on FAA safety philosophy and regulations. Among the devices discussed in detail are conditioning and pneumatic systems, stabilizer-adjustment mechanisms, landing gear, brakes, thrust reversers, pressure-sensing instruments, doors and exits, and swing-tail fuselages.

**Over-all Braking for Jet Transports.. 60—Av-2...**By D. E. Nichols, Assoc. Mem. ASME, Boeing Airplane Company, Renton, Wash. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

All of the factors influencing ground deceleration of jet-transport aircraft are generally discussed. Brakes are shown to be relied upon to do the major share of the work in stopping the airplane. Specific emphasis is placed on the design and test requirements of the wheel brakes and their service usage.

There are two broad categories of aircraft brakes; namely, drum-type and disk-type. A drum brake is typified by a conventional automobile brake, whereas the disk brake is not unlike the coaster brake on a bicycle. It is difficult to design high-energy drum-type brakes into restricted space, particularly when drum-section thickness must be such as to avoid heat-distortion problems.

With a disk-type brake, it is possible to fit a considerable heat-sink mass into the relatively small space available inside a typical aircraft wheel.

A brake design must begin with a knowledge of its torque and energy requirements. The brake-torque requirement will increase as velocity decreases in order to maintain a constant deceleration rate. Design of brakes must include consideration of the adverse environment in which a brake operates—the heat of its own creation, since a brake is a device for converting mechanical energy into heat.

The object of this article is to acquaint others with the general nature of the stopping problem and to act as a guide to those setting up requirements for design, test, and performance of aircraft brakes. The mathematics of airplane ground deceleration are included but are purposely separated from the main text so as to better serve the interest of the general reader.

**Uniform Design Criteria..60—Av-36...By J. C. Wightman, Wright Patterson Air Force Base, Ohio. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).**

The Air Force "Uniform Design Criteria" program has formulated physical design criteria for airborne electronics to increase flexibility; to improve reliability and maintainability; to reduce airframe support penalties; and to conserve engineering resources.

Proposed means to these ends are discussed and current applications presented. A review of accruable benefits concludes that this consistency of approach and continuity of philosophy are of extreme potential benefit to the military.

Benefits in terms of reliability are, primarily, a result of the modular-design concept. The other aspect of reliability is protection of equipment from adverse or damaging influences. This is a cooperative responsibility of airframe-provided protection and equipment capabilities.

The UDC approach presupposes that equipment will be designed to the highest state of the art; it also presupposes that the equipment will not be abused. Reliability in service thus becomes an ever-increasing airframe responsibility.

From the maintainability standpoint, easy and rapid go-no-go localization of a faulty unit in an aircraft by low skill level personnel with a minimum of test equipment is stressed to expedite the return of aircraft to flight status through replacement of the faulty unit.

Repair of units is considered a bench operation through rapid detection of the defective module and replacement thereof. On the module level, the desirability of the throw-away approach has been indicated, if economically feasible. It is maintained that application of these principles will materially improve all aspects of logistics and maintenance at all levels.

**Modular Design..60—Av-32...By H. L. Dudley and A. M. Maher, Melpar, Inc., Falls Church, Va. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).**

This is both a philosophical document to explain the importance of the modular design concept, and a technical presentation to show the present state-of-the-art of modular design including reliability, heat transfer, size and weight, and testing.

The authors emphasize that there must be specifications and standards to set objectives. These objectives will change as the state-of-the-art advances. A minimum design goal must be established; interchangeability must be striven for along with reduced logistics, reduced development time, reduced maintenance costs, and increased reliability.

They have attempted to establish a scale, or standard, by which design engineers can measure the performance advantage of new modules against the reliability advantages of the proved modules. In accomplishing this, human factors involved should be considered.

Even during the development of new systems many basic electronic circuits are repetitiously designed and redesigned. This circuitry can be replaced by proved circuits of modules, thereby enabling the design engineer to devote full time and attention to new design area.

The heat-transfer tests, shock and vibration requirements, and the sequential life tests all help to establish a minimum scale to which engineers must design equipment to meet the ever-increasing demands of modern weapons systems.

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## Process Industries

**Towards Resolution of the Chaos and Confusion in Our Systems of Units..60—SA-26...By Carl F. Kayan, Fellow ASME, Columbia University, New York, N. Y. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).**

Confusion is incurred in the use of "English" units systems in the U. S. A. versus the use of metric units in the U. K. and in the use of absolute versus gravitational (technical) systems of measurement.

To pave the way for future progress in resolving the confusion between the various existing systems of weights and measures in this and other countries, the author suggests a program which provides for:

1 Decimalization of the pound and the inch, with consumer-public aspects.

2 Revision of the elementary-school arithmetic programs, and development of new *National arithmetic* attitudes, using decimal values.

3 Gradual introduction of the kilowatt for general energy rates, with elimination of *refrigeration ton*, *horsepower*, and similar items.

4 Development of dimensionless presentation of data, with citation of the basic reference values in a variety of unit systems.

5 Promotion of "bilingual" and "duo-philosophic" operating skills in unit systems, inclusive, particularly of the MKSA system, for the "intellectual elite" of the mechanical engineers working in the international engineering sciences.

**The Free Expansion of Dry and Moist Air..60—SA-23...By J. H. Potter, Mem. ASME, Stevens Institute of Technology, Hoboken, N. J.; and M. J. Levy, Newark College of Engineering, Newark, N. J. 1960 ASME Summer Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Indus.; available to April 1, 1961).**

If a gas is permitted to expand freely from a vessel of constant volume, the gas remaining in the vessel is generally considered to undergo reversible adiabatic expansion. For such a case, the theoretical backgrounds are developed from the points of view of thermodynamics and gas dynamics.

Experiments are reported in which it is shown that, for expansions occurring over short time intervals, the temperature changes are essentially those predicted for reversible adiabatics. Some speculations are offered as to the mechanisms obtaining in the slower expansions.

## Materials Handling

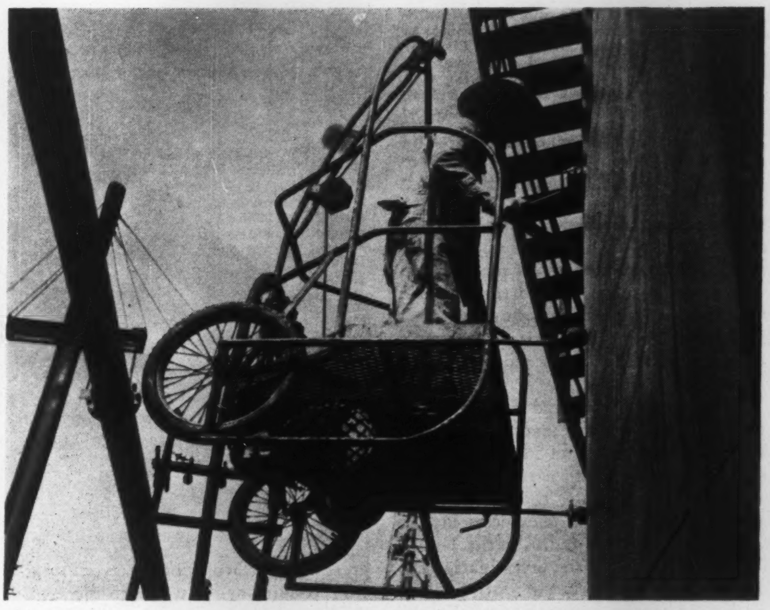
**Materials Handling in Maintenance Work ..60—SA-19...By Jodie Isenhower, Humble Oil and Refining Company, Baytown, Texas. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).**

To meet the high cost of maintenance labor the refining industry has devoted considerable time and expended large sums of capital to reduce such labor.

A significant amount of this maintenance labor is spent in the handling of materials. Most of this handling work is incidental to other repair work and any improvement in material handling must be tied in to the improvement of the over-all work methods.

This paper discusses the approach used by a large Gulf Coast refinery to improve its efficiency in performing material-handling work and reduce costs. Covered in detail are handling facilities for field work, transportation equipment, dirt-handling equipment, facilities for shop work and for handling people.

A follow-up work method to insure full and proper use of new material-handling equipment is briefly discussed.



Stage used for painting and repair work by a Gulf Coast refinery. Such equipment helps to reduce the amount of labor required for maintenance work (60—SA-19).

## Heat Transfer

**Temperature Distribution in an Internally Cooled, Heat-Generating Solid..60—SA-15...By E. M. Sparrow, Assoc. Mem. ASME, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).**

In an internally heat-generating solid such as a nuclear reactor, temperature nonuniformities may serve to produce significant thermal stresses within the material. In addition, for a reactor, certain temperature-dependent nuclear characteristics may be affected. Thus a knowledge of the temperature distribution throughout the material is an important requisite for the design of devices in which there is internal heat generation. The determination of such temperature distributions is the subject of the paper.

An analysis is made of the temperature distribution in a solid having uniform internal heat generation and internal cooling provided by parallel flow passages arranged in regular array.

Consideration is given to circular passages arranged in square and in equilateral-triangular patterns. Expressions are provided from which the temperature at any point in the solid can be computed for spacing ratios (spacing between centers/passage diameter) ranging from 1.05 to indefinitely large values. Representative temperature distributions are displayed graphically.

The maximum temperature (hot-spot temperature) in the cross section is presented as a function of the spacing ratio. Also, the variation of the heat removal around the circumference of a given cooling passage is shown and discussed.

**A Thermal Study of Composite Heat Sinks..60—SA-22...By J. V. Beck, Assoc. Mem. ASME, AVCO Corporation, Wilmington, Mass. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).**

Because the heating conditions generated by a body re-entering the earth's atmosphere from space or in certain other applications are so severe, the actual thermal conditions must be more closely simulated by including the effects of temperature-variable thermal properties and time-variable heating in calculations.

When these conditions are introduced into the problem of determining the temperatures of a heat sink, the problem is not amenable to exact solution. However, the solution can be calulated within the limits of engineering accuracy by using either a digital computer or, in certain cases, the simplified manual methods described in this paper.

Classical techniques as well as the digital computer are utilized to determine temperatures in a heat sink. The objectives are: (*a*) To investigate and determine the effect of the important parameters of heat sinks subject to variable conditions of arbitrary variable-in-time heat flux, temperature-variable thermal properties, and composite materials; and (*b*) to provide techniques to aid calculations by machines and hand.

**A Study of Free-Convection Boundary-Layer Oscillations and Their Effects on Heat Transfer..60—SA-25...By J. P. Holman, Assoc. Mem. ASME, H. E. Gartrell, and E. E. Soehngen, Wright-Patterson Air Force Base, Ohio. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).**

Wave length, wave speed, and wave amplitudes of artificially induced oscillations in a free-convection boundary layer on a vertical, isothermal, flat plate were measured with a Zehnder-Mach interferometer.

It was found that, as the oscillations amplify in their movement up the plate, the wave energy increased more rapidly in the outer layers of the boundary layer than in the layers close to the wall.

It is postulated that transition to turbulence begins when this energy becomes sufficiently large and the experiments furnish some confirmation of this postulate.

The boundary layer will absorb energy more readily at some frequencies than at others so that there is a disturbance frequency which will produce a maximum wave amplitude.

It was observed that the time-averaged heat-transfer coefficient for the oscillating boundary layer was the same as the theoretical steady-state value, within the range of the experimental error.

**Effect of Aspect Ratio and Tube Orientation on Free-Convection Heat Transfer to Water and Mercury in Enclosed Circular Tubes..60—SA-21...** By F. W. Larsen, Mem. ASME, FluiDyne Engineering Corporation, Minneapolis, Minn.; and J. P. Hartnett, Mem. ASME, University of Minnesota, Minneapolis, Minn. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1961).

Free-convection heat transfer to water and to mercury in a circular tube closed at the bottom end, open to a cooled reservoir at the top, and heated through the wall with a uniform heat flux has been investigated with emphasis on the effect of length-to-radius ratio and tube inclination.

Dimensionless wall and fluid temperatures are presented for several tube inclinations over a range of imposed dimensionless heat fluxes to a tube of length-to-radius ratio 14:6; these results are compared to earlier measurements in a tube of length-to-radius ratio 21:0.

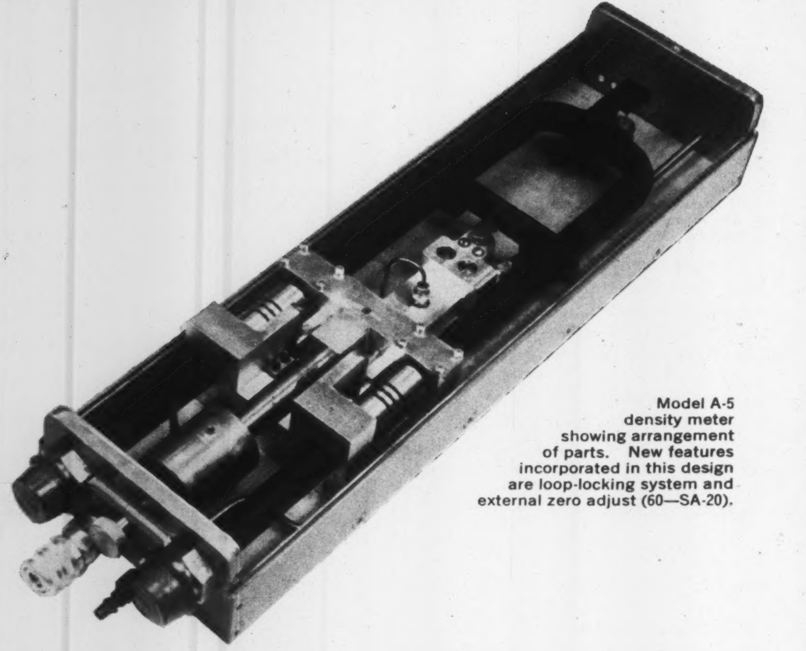
Over the range of the investigation the flow was apparently in fully mixed turbulent motion, as evidenced by the large fluid temperature fluctuations recorded during the tests. Inclination of the tube was found to result in a considerable decrease in temperature fluctuations and a corresponding increase in heat transfer above that observed with the tube axis vertical.

**Experimental Determination of Limit of Supersaturation of Nitrogen Vapor Expanding in a Nozzle..60—SA-8...** By G. L. Goglia, Mem. ASME, North Carolina State College, Raleigh, N. C.; and G. J. Van Wylen, Mem. ASME, University of Michigan, Ann Arbor, Mich. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1961).

The limit line of supersaturation of slightly superheated nitrogen vapor as it expands in a two-dimensional nozzle has been determined. The results indicate that the degrees of supersaturation vary from 12.3 F at a condensation temperature of 109 R to 3.5 F at 126 R. These results are in agreement with work of other investigations with nitrogen gas initially at room temperature.

Results of the investigation are shown in graphs. The calculated temperature at the point of condensation is plotted against the condensation pressure. The vapor-pressure curve for nitrogen is shown on this same plot. A limit line of supersaturation is drawn; the trend of curvature of the limit line is such that it appears as though at critical conditions supersaturation ceases to exist.

This limit of supersaturation curve can be used to predict the onset of condensation as well as the number of degrees of supersaturation for given stagnation conditions. An isentropic expansion from some initial stagnation condition will intersect the limit-line curve and this intersection indicates the temperature and pressure at which condensation should be expected.



Model A-5 density meter showing arrangement of parts. New features incorporated in this design are loop-locking system and external zero adjust (60—SA-20).

**The Influence of Bypass Channels on the Laminar Flow Heat-Transfer and Fluid-Friction Characteristics of Shell and Tube Heat Exchangers..60—SA-7...** By F. L. Test, Assoc. Mem. ASME, University of Rhode Island, Kingston, R. I. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1961).

Material presented in this paper represents a continuation of the work discussed by the author in a previous paper. The new data extend further into the laminar region and also include information on the experimental units for isothermal and heating runs in addition to the usual cooling runs.

It was felt that the data could best be correlated when the flow was considered a combination of flow across the tubes and parallel to the tubes. In order to investigate this conclusion, runs were made with an unbaffled heat exchanger in addition to the usual cross-baffled units.

The effect of tube bundle to shell clearance, mean oil temperature, mean water temperature, and oil flow rate on the shell-side heat-transfer film coefficients and pressure losses for laminar flow in unbaffled and cross-baffled heat exchangers is discussed.

The results for cross-baffled heat exchangers can be correlated by considering the flow to be a combination of flows parallel to the tubes and across the tubes.

## Petroleum

**Development of a Continuous Fluid Density Measuring Device..60—SA-20...** By G. V. Copland, Halliburton Oil Well Cementing Company, Duncan, Okla. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

The petroleum and chemical industries have many processes where it is desirable to measure and record fluid density of slurries continuously. A hollow beam, through which a fluid sample is circulated, is an integral part of a pneumatic null-balance system used to measure the density of the fluid.

The instrument had to be capable of handling water-cement slurries as well as sand-oil mixtures. This field instrument, of necessity, had to be rugged, serviceable as well as accurate, and economical.

The development of the U-tube system as well as the straight-through model is covered. These designs have been proved by several years of field testing; they have handled slurries such as cement-water, sand-oil, uranium-ore sulfuric acid, perlites-water, milk of lime, plaster of paris-water, and rocket-fuel constituents.

## Human Engineering

**Human Factors Evaluation of a Keyset Entry Technique for Frequency and Channel Selection..60—SA-38...** By D. E. Page and I. A. Goldberg, International Telephone and Telegraph Laboratories, Nutley, N. J. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April, 1961).

The development of modern high-speed aircraft weapon systems has generated a unique requirement for controls and displays which occupy minimal panel space and have minimal weight. Various integrated control and display systems have been designed in attempts to achieve simple and adequate satisfaction of required operational functions without compromising the severe constraint of permissible equipment size.

This report presents part of a human-factors evaluation of a frequency and channel selection keyset panel which was developed for one such integrated control and display system. This keyset panel provides controls for the selection and tuning of ten different communications equipment functions. The operator selects the equipment to be used by depression of an appropriate button. He then selects a desired channel or frequency number (of 5 digits or less) by operating a set of bidirectional rocker-arm slewing switches; the selected number is displayed to him simultaneously with its selection.

The experiment investigated the time and error characteristics of the keysetting operation. The frequency and channel selection system was designed so that depression of a rocker-arm switch on the keyset panel would set up a constant slewing rate of digit change. Alternatively, the design could be such that each switch depression would result in only a single unit change in the displayed digit regardless of the duration of switch closure.

Therefore, in order to determine the most efficient mode of operation, the discrete mode of digit change was compared with four slewing rates. The discrete pulsing mode of switch operation resulted in faster keysetting than any of the four slewing rates of digit change.

**Manual Attitude Control in Space—Arrangement of Controls..60—SA-34**...By M. L. Ritchie and L. F. Hanes, Ritchie and Associates, Inc., Dayton, Ohio. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

An experiment was run to determine the effect of arrangement of controls on the ability of human operators to stop the spin of a simulated symmetrical orbital vehicle.

The results indicate that it did not make a practical difference in performance whether the controls were grouped for operation by one hand, one hand and two feet, or two hands and two feet.

The mean performance resulted in the use of 11.2 deg/sec of control action to stop an average vehicle spin of 10.4 deg/sec. The mean time score was 8.4 sec.

The performance of the subjects in this and preceding experiments suggests that further reduction in performance scores may more readily be achieved through investigation of display techniques rather than through further studies of control arrangement.

**The Effect of Scale Form on the Speed and Accuracy of Scale Reading..60—SA-35**...By L. E. Wilkerson, G. A. Fox, and W. G. Matheny, Bell Helicopter Corporation, Fort Worth, Texas. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

The Army-Navy Instrumentation Program has as one of its responsibilities the determination of the best method of presenting precise quantitative information. Recently, investigators have shown a great deal of interest in linear vertical tapes as a possible improvement over the more standard circular scale type of instrument.

The central question is that of the effect of scale form and scale-pointer relationships on the speed and accuracy of scale reading. The experiment reported was designed to evaluate three types of displays — circular-moving pointer, linear-fixed pointer, and linear-moving pointer. The results are discussed relative to the number of fixations possible with the exposure time used.

It was found that:

1 Reading the scan area tended to reduce the number of reading errors. It also equated the number of errors one unit from a major graduation mark and two units away from a major graduation mark.

2 If speed and accuracy of reading quantitative information are the prime criteria, these data show the circular scale to be superior.

**Task Performance With the CRL Model 8 Master-Slave Manipulator as a Function of Color-Coding, Distance, and Practice..60—SA-37**...By B. M. Crawford, Wright Patterson Air Force Base, Ohio. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

When work must be accomplished in an environment that cannot be tolerated by the human organism, some type of remote-handling system becomes imperative. Devices and techniques have been developed and used for the handling of radioactive materials in the "hot lab."

A popular remote-handling device is the Argonne National Laboratory Model 8 master-slave manipulator which, as its name implies, consists of two basic sections, the master control and its slave. Mechanical linkages enable the slave to perform a task in duplication of the actions of the remote master control.

The master-slave congruity concept, with bilateral force reflection for all motions, represents an attempt to capitalize on the natural characteristics of the operator and minimize reasoning and training requirements. It facilitates the operator's ability to identify the slave and its actions with the corresponding components and functions of his own body. This identification process contributes much toward the effectiveness of complex remote manipulation.

This study was designed to examine task performance time as a function of two variables: (*a*) Slave jaw color, and (*b*) distance between the operator and the remote-handling task.

Results showed that:

1 Color-coding of the slave hands is not sufficiently effective in tasks of this nature to bring about a significant improvement in performance.

2 Work time increases as a function of increased distance between the operator and the task, especially when the distance approaches the range limit of the manipulator.

3 The work ratio of direct handling to remote handling for tasks of this nature is approximately 1:8, varying directly with distance between the operator and the task.

4 Decrease in time-per-trial for this task becomes significant in only three trials. The effect of practice is represented by the typical curve of decreasing gains.

## Machine Design

**Studies of the Design of Steel Castings and Steel Weldments as Related to Methods of Their Manufacture..60—SA-2**...By H. R. Nara, Mem. ASME, D. K. Wright, Jr., Assoc. Mem. ASME, Case Institute of Technology, Cleveland, Ohio; and C. W. Briggs, Steel Founders' Society, Cleveland, Ohio. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1961).

Steel castings and steel weldments are competitive materials employed in ferrous metal fabrications. They are at times used as replacements for each other in engineering structures, depending on the cost and quantity differential and the familiarity which the designer has in the material of construction and the service application of the particular engineering structure.

The studies of this research were undertaken with the express purpose of providing information on the design of steel casting and weldment sections and a comparison of the properties of these sections, so that the design engineer may by more familiar with the engineering characteristics of these two methods of fabrication for use in stress-carrying parts of engineering structures.

The L design is probably the most common method of joining sections in any engineering structure, and its design extension, the box section, is likewise found in numerous machines and structures. The studies of this research were designed to collect experimental data on the response of these sections, when produced as steel castings and weldments of wrought steel plates, when they were subjected to static and dynamic loads. The performance of these structures was then compared.

Among the conclusions drawn are the following:

1 Normal structural parts, as produced in steel castings, are stronger under static loading than commercial weldments for a given design because of the higher carbon, manganese, and silicon contents in steel castings and therefore the generally higher tensile strength steel employed for castings.

2 Steel castings generally have better fatigue properties than weldments for the corner design studies.

3 Steel-casting corner designs had fewer discontinuities than the weld-fabricated corners.

4 Corner designs produced as steel castings resulted in lower stress concentration than existed in comparable designs as produced by fabrication welding.

**Design of Flapper Valves..60—SA-3...** By P. R. Paslay, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1961).

Elastic behavior of flapper valves is of interest because the stresses occurring in service are often quite high and the characteristics of these valves (e.g., deflection per unit loading) are nonlinear, and this effect must be taken into account in flow calculations.

This paper gives a derivation of a solution, based on the principle of minimum potential energy, for determining the static deflection of a particular design of flapper valve that is a thin flat circular disk with radially cantilevered "fingers." The valve is supported at the ends of the fingers and the disk is loaded with a uniform pressure.

This analysis should be satisfactory for design as long as the geometric restrictions given in the analysis are not violated and the frequency of the pressure fluctuations is below the lowest natural frequency of the valve on its supports.

Results show that to obtain adequate predictions of the deflections and stresses of the valve for all but the first increment of loading the nonlinear aspects, caused by change in configuration, must be considered. This analysis includes the nonlinear effects in the range of interest for many flapper valves.

**Analysis of Buckling Column Spring With Pivoted Ends and Uniform Rectangular Cross Section..60—SA-10...** By Alexander Blake, Mem. ASME, Associated Spring Corporation, Bristol, Conn. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1961).

When an initially straight and slender column of uniform cross section is subjected to a compressive end load lower than the critical buckling load, the corresponding deflection is very small and difficult to determine. However, as soon as the critical load is exceeded, the column snaps out of the initial position of equilibrium almost instantly and the deflection begins to increase smoothly at a constant rate.

Design formulas and working charts are derived for predicting load-deflection characteristics and maximum bending stresses in initially straight buckling column springs, of uniform cross section, considered to be pin jointed at the supports.

Load-deflection analysis is based on the study of a slender bar, compressed beyond critical buckling, made by Lagrange. Stresses are calculated using the elementary strength-of-materials theory. The predicted load-deflection curves for typical spring proportions are compared with the experimental results.

**The Vibration of Shaft Ropes With Time Variable Length, Treated by Means of Riemann's Method..60—SA-16...** By W. J. Shaffers, Mining Research Establishment of the Dutch State Mines, Treebeek (L), Netherlands. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1961).

Longitudinal vibrations in the ropes of a mining hoist, introduced by application of the emergency brake, are complicated by the change in rope length during the braking action. The usual method of the Laplace transform cannot be applied to the governing one-dimensional wave equation $y_{tt} - a^2 y_{xx} = 0$, since the field of integration deviates from the semi-infinite strip $0 < x < l_0$, $0 < t < \infty$.

In this paper it will be shown how the rigorous solution can be found by using Riemann's method of the characteristic curves. Instead of the boundary values for the deviation $y$, certain differential relations are given which describe the dynamic conditions at the discrete masses, e.g., the cages and the Koepe pulley.

## Management

**Understanding the Creative Engineer..60—SA-33...** By H. R. Buhl, Assoc. Mem. ASME, Iowa State College, Ames, Iowa. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

Characteristics of creative-engineering students are studied. Test results show likes and differences between the highly creative and the less creative engineer. These results are interpreted in the light of current educational and engineering practices.

It is concluded that the highly creative engineer is differentiated by his deep interest in other people. He is interested in and highly motivated by others. While his high creative ability and his scholastic achievements do not always correspond, it is shown that under the proper conditions the two would correlate.

It is noted, also, that the creative engineer should be most productive while working under permissive supervision and with well-defined humanitarian goals. Working conditions should be encouraged where creative ideas are socially acceptable and excellence rewarded.

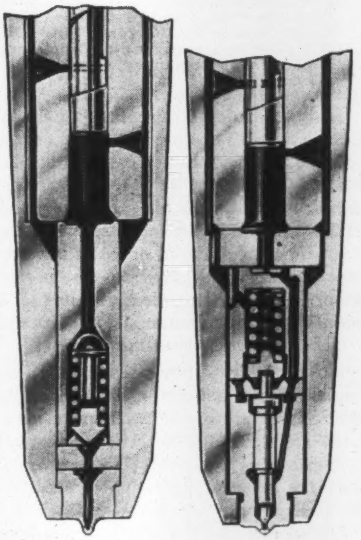
## Oil and Gas Power

**Power Cost Studies for Systems With Diesel Generating Stations..60—OGP-12...** By W. H. Reed, U. S. Department of Agriculture, Washington, D. C. 1690 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

Power-cost studies are needed to test the relative economic advantages of different power sources or combinations of sources. This paper outlines a technique for estimating power costs where diesel generation is the principal power source.

The costs and expenses are from a study made for an operating system which required a substantial addition to its power supply. They are intended only to illustrate the method, as some of the elements of the costs will show considerable variations among systems and plans. The diesel plant arrangement is somewhat unconventional and shows a possibility that engineers considering large power sources may wish to investigate further.

The illustration for this presentation is based on a proposed installation using two spark-fired, 3500-kw, gas diesel engines connected back to back to a 7000-kw generator. Two of these 7000-kw generators are connected in parallel electrically and serve a single step-up transformer. This arrangement would result in 14,000 kw of capacity operation as a unit.



Comparison of the standard differential valve-type nozzle, **left**, with A.B. conversion, **right**, which eliminated nozzle coking due to fuel dribble (60—OGP-9)

Each unit would have its particular auxiliaries and controls. Automatic supervisory control is included to insure most efficient operation and a minimum of labor expense. This arrangement will bring the number of major components more nearly in line with steam-plant practice. There should be a saving in investment as compared with four separate 3500-kw generator sets, higher efficiency, and a minimum of labor expense with this arrangement.

**Application and Range of the Tuned Housing Vibration Damper..60—OGP-5...** By E. A. Moorehead, The Cooper-Bessemer Corporation, Mount Vernon, Ohio. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

The tuned housing vibration damper is discussed as a tool readily available for two important jobs:

1 To raise engine-mode critical frequencies, allowing higher operating speeds and subsequent higher horsepowers.

2 To obtain more torsional vibration-damper effect by increasing the amplitude of the damper relative to the engine, allowing control of a wide range of obstinate criticals stimulated by the engine in complex torsional systems.

Graphs are presented to show the results of the use of a tuned damper. Damper-tuning theory is discussed along with several applications; also, various tuning devices are described briefly.

**Nozzle Design Cuts Locomotive Costs.. 60—OGP-9...** By W. J. Gewinner, American Bosch Arma Corporation, Springfield, Mass. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

The background for a design of a differential valve-type nozzle incorporated in the unit injector of a locomotive diesel engine is outlined with the potential savings to railroads evaluated.

The practicability of the use of cheaper lower grades of fuel enhances the application of these units on locomotives, aiding the railroads to combat competition, and tends to stabilize their current economic difficulties.

Experience with these injectors in all types of service on a number of railroads has indicated a definite gain in specific fuel consumption with an over-all average of 4 per cent improvement.

**Some Experimental Results From a Two-Cycle Diesel-Engine Exhaust-Waste Heat Exchanger..60—OGP-13...** By J. C. Georgian, Mem. ASME, Washington University, St. Louis, Mo. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

Experiments and records of the results of tests on an exhaust-waste heat exchanger are described. The exchanger under consideration is of the shell-and-tube type. The diesel exhaust is passed through the tubes and the water is passed through the shell.

The exhaust heat was obtained from a three-cylinder, opposed-piston, two-cycle, Fairbanks Morse Model $38E5^1/_4$ diesel engine. The engine was first operated for an extended period of time to foul the heat-exchanger tubes in order to simulate actual operating conditions.

The test runs were made at the maximum load the generator could carry, approximately 50 per cent over the rated load, and at 125 per cent, 100 per cent, and 75 per cent load. The engine was run under these conditions at the rated speed of 1200 rpm. Operation was continued until steady-state conditions were obtained and readings taken every half hour for about six hours, and then averaged.

In order to obtain a correlation, test runs were also made by bypassing the heat exchanger and exhausting directly to the atmosphere through an exhaust pipe, and also by bypassing the heat exchanger and exhausting through the silencer.

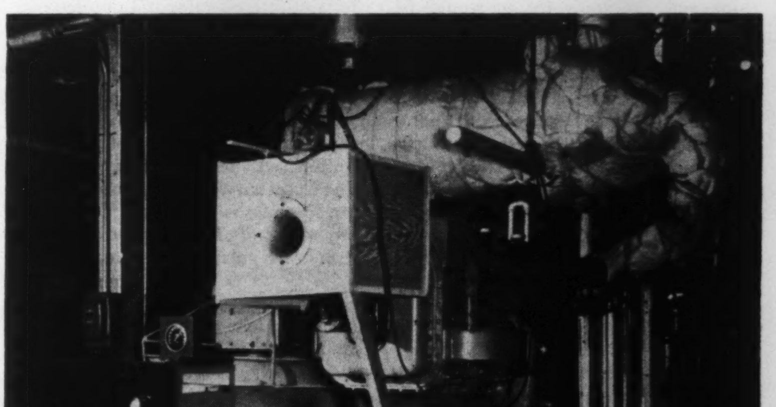
Test results include heat-transfer and pressure-drop data plotted on dimensionless co-ordinates. Data on dry and part-dry operation, the dryness of the steam produced, and data on the silencing characteristics of the heat exchanger are given.

An equation is included that can be used as a design equation for waste heat exchangers using diesel-exhaust gas.

**System Stability Analysis Including Governor, Engine, Generator, and Tie-Line Impedance..60—OGP-10...** By L. D. Brinson, Mem. ASME, Nordberg Manufacturing Company, Milwaukee, Wis.; G. Parker, Woodward-Governor Company, Rockford, Ill.; and F. S. Rothe, General Electric Company, Schenectady, N. Y. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

A number of diesel engine a-c generating plants have experienced abnormal power swings when operating in parallel with a tie-line connected to another generating system. This usually shows up as a load swing and may be noticeable in a frequency change.

View of experimental exhaust waste-heat exchanger for a two-cycle diesel engine showing air-flow nozzle, manometers, and fuel scale (60—OGP-13)



This paper presents an analysis of this problem considering the following elements of the system: (*a*) The generator; (*b*) the power system and load; and (*c*) the engine-governor and fuel supply.

A simple procedure is given so that engine manufacturers can determine in advance whether such disturbances might occur in a particular installation.

From the analysis presented in the paper, several conclusions can be stated:

1 The tendency of a-c engine-generators to be subject to speed and power pulsations when operating in parallel with other units can be represented numerically by the value of the damping torque coefficient for the system. This coefficient, $T_d$, is the algebraic sum of the damping from the generator, which is connected to the power system, and the damping from the engine, governor, and fuel supply.

2 The damping torque from the generator alone is always positive but may be substantially reduced by tie-line reactance.

3 The damping from the engine governor may be negative at some pulsation frequencies due to time delays in the response of engine torque to changes in speed.

4 It is possible for an engine manufacturer to use the simple approximate curves presented in this paper together with a relatively small amount of information from the generator and governor manufacturers to find the value of the net system damping.

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## Production Engineering

**The Simultaneous Development of Machinery and Tools..60—Prod-6...By R. K. Sedgwick, Kearney and Trecker Corporation, Milwaukee, Wis. 1960 ASME Production Engineering Conference paper (multilithograped; available to March 1, 1961).**

The decision to develop a machine tool and the tools used in it confers a great boon upon the designer, but at the same time subjects him to several severe limitations. The results of such a program are almost certain to be superior to any divided approach.

A typical effort of the unified type is described, detailing some of the problems and unexpected benefits. The degree of public acceptance and how it was effected by the united development approach are described, along with some of the factors involved in "interdenominational" dealings within the machine and tool industry.

Simultaneous development of a machine and the tools for it would be expected to produce superior results in two ways: (*a*) Each of the two could be designed to take advantage of the most modern features available, without the handicap of any preassigned limitations due to the characteristics of the other; and (*b*) the release of both designs can be held until both are considered satisfactory, and changes can be incorporated right up to the last minute.

In these respects, the whole project can be carried on with a minimum of waste. On the other hand, since the entire program was so radical in basic principle that most of the relevant mechanical elements were almost unprecedented, each element had to be developed from an extremely meager technical inheritance. Hence many changes involving both machine and tool made necessary the wholesale scrapping of layouts that had been carried to completion.

In general, it may be said that the simultaneous technique is in order where the anticipated sales volume of the resultant equipment justifies the number of engineering hours that are necessarily consumed, and where the degree of advancement produced is such that there is not the often-present need for racing against the efforts of competitors.

**Mathematical Models for Analysis of Job Shop Capital Equipment..60—Prod-9...By J. F. Fowler, Assoc. Mem. ASME, The Falk Corporation, Milwaukee, Wis. 1960 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1961).**

Various formulas have been developed in the last decade to appraise the relative urgency of capital investment proposals. Traditional rules of thumb neglected the effects of interest rates and obsolescence. These and other considerations are included in recent formulas designed for specific purposes.

Management of the job shop is frequently faced with irregular problems beyond the scope of simplified formula solution. A more general approach using present-worth equations rather than formulas is suggested.

By means of elementary present-worth factors, irregular circumstances can be analyzed on a more intimate basis. A method of developing these factors by approximation methods of integration (Simpson's parabolic rule) is proposed.

Ultimately these factors and the present-worth equation can be used with probability multipliers in a matrix solution of more involved capital equipment planning.

**Factor Management and Labor Controls..60—Prod-11...By G. D. Wolfe, A. O. Smith Corporation, Milwaukee, Wis. 1960 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1961).**

It is difficult to visualize how any business can operate without some ideas and methods of cost controls. Since labor is one of factory management's most controllable cost items, good labor controls are essential to any management program. In order to develop and install an accounting system for labor controls, considerable time and money are required; and additional overhead is required to maintain it.

To introduce labor controls into an organization, policies must be set up stating that all work-measurement standards are developed for the purpose of being used as a basis for labor controls, and that these standards are to be used to determine and establish productivity requirements, not as a system for pay purposes.

In the paper, mechanics of controls are covered, taking into consideration three direct labor controls—producer employees' (*a*) per cent performance, (*b*) per cent on measured work, and (*c*) per cent on nonproductive work.

Further mechanics are given: (*a*) Per cent on productive work; (*b*) utilization ratio which is a check on how effectively the productive work force is utilized on productive work, based on the hours earned and attendance hours clocked; (*c*) realization ratio which utilizes the same attendance hours used in utilization ratio plus all attendance hours for producers and nonproducers as a base and acts as an indicator of how well management is controlling the total hourly paid work force.

A productive labor analysis is suggested that will (*a*) indicate tool or mechanical troubles where consistent failures cause the operations to run nonstandard; (*b*) indicate whether any one particular operation is within the control limits for performance and earnings; (*c*) provide a direct comparison of methods and resulting changes in the work-measurement standards; (*d*) provide a basis for substantiating applied work-measurement standards in grievance meetings where direct comparative analysis of earnings is needed; (*e*) aid accounting and industrial engineering to uncover erroneous standards or clerical errors; (*f*) summarize the total debit or credit variances in the department or division in terms of direct labor hours used in any one given time period.

The author concludes that the accuracy of the labor control system will depend on the administration and management's desire to control. The entire program is based on an assumption that a standard cost-accounting program is desirable or in use. Charts are included throughout to illustrate ideas.

**Rigidity and Stability of Machine Tools.. 60—Prod-18...** By Miroslav Sadowy, Marquette University, Milwaukee, Wis. 1960 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1961).

For satisfactory performance it is obvious that the machine tool must be able to withstand the loads occurring during operations. The loads can be static or dynamic, the latter having periodic or impact characteristics. Being associated with the cutting process and/or the movements of machine tool members, these forces act between the workpiece and the cutting tool and at other locations in the machine tool.

The forces must be considered disturbing if they cause machine-tool members to move or deform detrimentally. Such a disturbing response of a machine tool to the loads acting can be considered from the following two points of view:

1 Behavior caused entirely by a load and persisting only during the period of action of the load.

2 Behavior only initiated by a load and also persisting after the load has ceased to act.

Within a given disturbing force the behavior of the machine tool is, first, a question of its rigidity (stiffness) and secondly, its stability. Since rigidity and stability are the main factors influencing machine-tool operation, measurements of rigidity and stability are essential to satisfactory determination of operating performance.

In this paper, rigidity and stability problems in machine-tool design, manufacture, and operation are indicated, and their historical development and the particular factors of influences are discussed. Characteristic results of experimental rigidity and stability investigations and a general discussion of machine tools as mechanical systems are included. Some special aspects of rigidity and stability are presented; e.g., the applicability to practical problems in machine-tool engineering of the methods of investigation described.

The possibility of comparative machine-tool tests is indicated. Emphasis is placed upon understanding of the dynamic behavior of machine tools as mechanical systems; design aspects are stressed.

ASME TRANSACTIONS

**The July, 1960, issue of the Transactions of the ASME—*Journal of Engineering for Power* (available at $1.50 per copy to ASME Members, $3 to nonmembers) contains the following:**

## *Journal of* ENGINEERING FOR POWER

Volume 82 • Series A • Number 3

**169** An Experimental Investigation of Fuel Additives in a Supercharged Boiler, by R. J. Zoschak and R. W. Bryers. (59—A-160)

**181** External Corrosion of Superheaters in Boilers Firing High-Alkali Coals, by P. Sedor, E. K. Diehl, and D. H. Barnhart. (59—A-76)

**194** Corrosion of Superheaters and Reheaters of Pulverized-Coal-Fired Boilers, by Wharton Nelson and Carl Cain, Jr. (59—A-89)

**205** Considerations for the Reduction of Noise in Ship Installations of Gas Turbines, by E. M. Herrmann. (59—A-238)

**215** A Torsional Vibration Problem as Associated With Synchronous Motor Driven Machines, by R. N. Brown. (59—A-141)

**221** Design Control of Overcompression in Rotary-Vane Compressors, by E. O. Bransford and R. A. Stein. (59—A-109)

**227** Operation of Steam Turbines to Minimize Shell Cracking, by S. B. Coulter and R. L. Jackson. (59—Pwr-10)

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# COMMENTS ON PAPERS

## The Manipulator: Its Design and Application

### Comment by Herbert H. Hall[1]

There is one point in this paper[2] on which I would like to comment. The great variety of auxiliary equipment used in materials handling, particularly crane attachments, is of interest to materials-handling men and I think this paper serves a useful purpose in drawing attention to some of the more recent crane grabs that are available. My only objection to the paper is the title, in calling these attachments "manipulators." The general use of the word manipulator describes a piece of positioning equipment that permits universal movement. To call crane grabs manipulators is stretching the point considerably, especially as the classification of materials-handling equipment defines manipulators and also crane grabs as separate pieces of equipment. It is true that certain industries have special names for equipment. For instance, the steel industry refers to all types of fork trucks as "tractors" which, of course, is incorrect, however, the term is in general use in the steel industry. Maybe certain companies or groups refer to crane grabs as manipulators. Personally, I have never heard it used in this manner.

The classification of materials-handling equipment under which crane grabs, such as described in this article, are listed is 282 and manipulators is 311. This classification of equipment appears in chapter 1 of the "Materials Handling Handbook" and was approved by the Materials Handling Division of ASME several years ago.

### Author's Closure

The dialogue of the representative of Management and of the Engineer contains terminology that is an adaptation of existing words to define operations of facilities that are new, outgrowth of functions of present age in missiles, metals, construction, and so on. Thus the word manipulator is used to describe functions which are listed in great detail in the paper and illustrated extensively therein.

It is true that in the past the word manipulator was limited in scope. However, we cannot limit terminology to past usage. The times change. In my lectures on Methods Engineering, there are several distinctly different terms used in relation to methods work in missiles, electronics, metals, andother industries. One is the word operational, another functional, the other is manipulation. These are specific uses of terminology and are and will be used regardless of the fact that past uses of these terms are different.

In the paper we were limited in our illustrations because of the nature of manufacturing and processing from which pictures were available. Thus in this paper we used some pictures of tongs, grabs, rotators. This probably justified to a degree the criticism of wrong use of words. However, the terminology used must be accepted in the light of the framework of modern operations.

**J. C. Somers.**[3]

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[1] Materials-handling consulting engineer, Pittsburgh, Pa.; General Chairman, ASA-MH5; Mem. ASME.

[2] J. C. Somers, "The Manipulator: Its Design and Application," Mechanical Engineering, vol. 82, February, 1960, pp. 64–65, based on ASME Paper No. 59—A-186.

[3] President, J. C. Somers & Associates, Industrial Engineers, Long Island City, N. Y. Mem. ASME.

## The Thinker

### To the Editor

Two exemplary bits of sloppy logic on pages 80 and 81 of the April issue cause me to wonder if "The Thinker" (depicted on page 80) is lost in thought or just plain disgusted.

Item 1. "The velocity of light is the same relative to anything that it strikes, regardless of the speed of the light source or of its target. This phenomenon can be ascribed to the fact that, in the four-dimensional geometry of the universe, light has effectively infinite velocity [11], which would thus be infinite relative to any target not having infinite velocity itself." (Third paragraph, second column, page 80.)

Are we to infer that, since the velocity of light is finite relative to us as targets, we have infinite velocity too? Perhaps, Mr. Mills might consider that velocity is not a geometric concept; therefore if time is made part of the geometry of the universe, nothing can be said to have a velocity in such a geometry. Instead, the points of our three-dimensional world get smeared out into "world-lines" of varying shape according as the history of motion of these points. Which does not explain why the velocity of light is constant. But who would try to explain why Pi is 3.141 . . . ?

Item 2. ". . . the airfoil is said to be in a 'stalled' position, Fig. 2. At this angle of attack, the resulting turbulence has destroyed the laminar layer of air-flow resulting in a loss of lift." As it turns out, an airfoil with a turbulent boundary layer can operate at angles of attack and lift coefficients several times greater than those attainable with the same airfoil operating with a laminar-boundary layer. (Re paragraph 3 of Mr. Kishi's paper, page 81.)

I have the greatest respect for Mechanical Engineering as a reliable, accurate, and readable source of engineering information; that is why the above items sparked this letter.

**J. C. Vrana.**[4]

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[4] Combustion engineer, Canadian Pratt & Whitney Aircraft Company, Longueuil, Que., Canada. Assoc. Mem. ASME.

### Author's Closure

The author feels that Mr. Vrana's comments reflect a difference of opinion on how to express an unfamiliar concept, rather than on any matter of logic. It is difficult to explain four-dimensional phenomena in such a manner as to be meaningful to mechanical engineers steeped in three-dimensional experience, and this difficulty led to the author's reference to the "effectively" infinite velocity of light in the four-dimensional universe. It is presumed that if a man were to travel to a distant star and back, at the speed of light, he would be no older when he returned than when he started. To the author, it appears reasonable to consider this traveler's velocity to be effectively infinite.

Blake D. Mills, Jr.[5]

### Comment by Pascal M. Rapier[6]

This paper[7] summarizes the conclusions in an excellent manner that those who deem themselves authorities in this area associate with the theory of Relativitity. However, since the engineer will accept nothing upon authority, but prefers to base his scientific opinions entirely upon the facts of the case, I shall present a few of these along with an up-to-date bibliography and shall leave it to readers to decide whether there is anything at all to be gained by trying to understand this enormously complicated and confused subject.

First, it recently has been determined [1][8] that the Ives-Stilwell experiments, which were thought by physicists to verify their conclusion that time runs slow in a moving system, have been misinterpreted. The data actually confirm Newton's statement that true time runs evenly and equably, and independent of everything external. In a like manner, the muon lifetime experiments have been twisted to imply consequences [2] entirely extraneous to their intended purpose and contradictory to the experimental evidence—consequences of asymmetrical aging, known as the twin paradox. Thus the best authorities have come to believe that while centuries may pass on Earth, relativistic space travelers will experience only the passage of minutes, and will become virtually immortal.

The truth about the muon lifetime experiments [3, 4] is that the data showed: (*a*) The effective energy of the cosmic ray muons was 1.3 Bev.; (*b*) the mean distance they traveled during their lifetimes was 9.4 kilometers; and (*c*) the mean lifetime was measured as being 2.2 microseconds.

From the effective energy of the muons, it has now been calculated that their velocity under Newtonian physics is about 13 times that of light [5]. Now if we divide the distance (*b*) they traveled during their lifetime by the mean lifetime (*c*) we obtain the true velocity of 15 times that of light, which is a reasonable check on the Newtonian prediction. Thus what this experiment actually tells us is that the velocity of light has been exceeded manyfold, and hence, tha tthe Einstein composition of velocities is false.

Second, the afore-mentioned experiment confirms Prof. Herbert Dingle's contention [6] that $w$, the true physical velocity, or the time rate of change of distance, equals $v(1 - v^2/c^2)^{-1/2}$, wherein $v$, the relativistic velocity, is only a mathematical convenience which has no real existence. Thus relativity does not rest upon any secure footing, as claimed by the authorities, but in the words of Professor Dingle, has always rested upon an assumption [7].

Third, in my most recent paper [5], I have shown that the gravitational red-shift of light, its deflection in a gravitational field, and the advance of the perihelion of Mercury are effects obtained directly by the application of Newtonian principles. The first of these, the Newtonian gravitational frequency shift, has just been verified by what is probably the most precisely deterministic experiment in history [8]. Moreover, I have shown that the red-shifts of distant galaxies, instead of being Doppler effects, are given under Newtonian physics precisely as a degradation of the energy of light rays, caused by a slight viscosity-like property of interstellar space, which is given by the third term of the Navier-Stokes equation of motion. This discovery removes a perplexing difficulty in cosmology, since under general relativity we have no choice but to believe that the red-shifts are Doppler effects, and consequently, that the whole Universe is exploding like an over-inflated soap bubble. [9]. Under Newtonian cosmology, however, the Universe turns out to be exactly as it was described in Newton's letters to Mr. Bentley, stable, infinite, static, and homogeneous on the average.

Finally, since there is now no physical evidence to the contrary, mass, distances, and time must be considered as being scalar invariants under Dingle's modification of the Lorentz transformation, which places three-vector true physical space in a one-to-one correspondence with the purely abstract concept of four-vector mathematical space. L. Essen [10] also has proposed similar changes in our physical concepts and believes that such considerations may require far-reaching changes in textbooks. The combined results of all experiments known today indicate that Newton's laws will give precisely correct results in the field of celestial mechanics, which field is becoming increasingly important to mechanical engineers. I find these concrete ideas, recently developed, much more satisfying philosophically than the abstractions I have been taught as a physicist and entirely in keeping with my engineering training and experience. I believe that most engineers will experience the same satisfaction with the results that can be obtained and will realize that the Einstein concepts are superfluous.

### References

1 P. M. Rapier, A.D.I. Document No. 5806, Library of Congress, $2.50.

2 F. S. Crawford, *Nature*, vol. 179, 1957, pp. 35–36.

3 Rossi, et al., *Physical Review*, vol. 57, 1940, p. 461.

4 F. Rasetti, Ibid.,vol, 60, 1941, p. 198.

5 P. M. Rapier, A.D.I. Document No. 6144, 1959, Library of Congress, $2.50.

6 H. Dingle, *Bulletin*, Institute of Physics, December, 1958, pp. 314–316.

7 H. Dingle, *Nature*, vol. 183, 1959, p. 1761.

8 R. V. Pound, *Physical Review Letters*, vol. 4, 1960, pp. 340–341.

9 A. Einstein, "Meaning of Relativity," 1956, Princeton University Press, Princeton, N. J., p. 128.

10 L. Essen, *Nature*, vol. 180, 1957, pp. 1061–1062.

### Comment by Gideon Kanner[9]

This article[7] raises an interesting problem.

The comment this writer would like to make is this. As pointed out by the author in the paragraph entitled "Basic Concept of Relativity," "...only the motion of any given body relative to other bodies in the Universe has any basic significance, and...there is no real meaning to the term 'absolute motion' because nothing in the Universe is stationary." The necessary implication of the cited passage is that any observer, anywhere in the Universe, is at liberty to construct a system of reference such that any motion will be measured relative to himself.

Applying this to the "twin paradox,"

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[5] Professor of mechanical engineering, Department of Mechanical Engineering, University of Washington, Seattle, Wash. Mem. ASME.

[6] Director, Newtonian Science Foundation, Richmond, Calif.

[7] B. D. Mills, Jr., "Relativity and the Mechanical Engineer," MECHANICAL ENGINEERING, vol. 82, April, 1960, pp. 78–80.

[8] Numbers in brackets designate References at end of comment.

[9] Senior research engineer, Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif. Assoc. Mem. ASME.

it may be readily seen that the twin in the space ship may so construct his system of reference and conclude that he is stationary while the Earth is receding from him at nearly the speed of light. Using the relativistic calculations he would be now in a position to conclude that time was passing more slowly for his earthbound twin and that consequently, upon return of the spaceship to Earth, the earthbound twin would be "younger."

It would thus appear that the twin paradox is not so much a paradox as a subjective observation varying with the observer's system of reference. Further elaboration by the author on the qualitative aspects of this problem would be appreciated.

### Author's Closure to Discussions by P. M. Rapier and G. Kanner

The author notes Mr. Rapier's discussion with interest, but does not consider it feasible to undertake here any defense of the theory of relativity, which has long continued to be a topic for challenge and debate.

The "twin paradox" of space travel has been argued at great length in the literature, by Drs. Dingle, McCrea, McMillan, Crawford, et al., and no brief comment here could be convincing.

However, in response to Mr. Kanner's discussion, perhaps the following may appear relevant. The situations of the traveling twin and the stay-at-home twin are not arbitrarily interchangeable. The twin remaining on earth has only a moderate velocity relative to the great mass of the universe (whose mass distribution is presumed roughly constant). The twin in the space ship traveling at nearly the speed of light has a very high velocity relative to the great mass of the universe. Regardless of which twin (if either) is considered as a stationary reference, these last two statements are true, and they point out a major difference between the individual situations of the twins. It is not primarily the speeds of the twins relative to *each other* that is presumed to determine their difference in time-rates, but rather the determining factor is their individual speeds relative to the great mass of the universe. These latter speeds cannot be interchanged by mental manipulation. A further discussion of this aspect of the twin paradox appears in Reference [6] of the author's article.

## Control of Air Pollution From Oil-Burning Power Plants

### Comment by L. H. Coykendall[10]

The Southern California Edison Company and the authors are to be commended for their progress report and their expenditures in manpower and money in an effort to reduce the air pollutants emitted from their power-plant stacks. Such commendation is particularly appropriate when it is recognized that these emissions are only a minor contribution to the smog conditions prevalent in the Los Angeles basin, as shown in Table 1 of the paper.[11]

Since late in 1956 my company, at the invitation of the Edison Company, has been collaborating with them in this effort, particularly in regard to the reduction of NO formation, as covered in the report[12] cited in this paper. We are continuing to do this, and a series of tests are scheduled in January to determine the effectiveness of two-stage combustion and the features incorporated in the design of the units recently placed in operation at Edison's Mandalay Station. These include burner spacings to provide exposure of individual burner flames to greater furnace-cooling surface, auxiliary air ports between the rows of burners as well as above the top row of burners, and a water-cooled hopper-type furnace bottom. The last feature is considered quite important, particularly when compared with the units at El Segundo where the refractory covered flat floor collects a pool of molten oil-ash which acts as a mirror to reflect the burner flames. A comparison of the burner spacings on the units at Mandalay and El Segundo is given in the following table:

| Station | El Segundo | Mandalay |
|---|---|---|
| Distance from side walls | 7 ft-$7^1/_2$ in. | 5 ft-$8^3/_4$ in. |
| Distance between burners, horizontal | 9 ft-3 in. | 7 ft-$8^1/_2$ in. |
| Distance between burners, vertical | 5 ft-3 in. | 10 ft-5 in. |
| Distance from flat floor or top of hopper | 5 ft-0 in. | 9 ft-9 in. |

Analysis of test data by our Research Center indicates that two-stage combustion also may be effective in reducing the formation of $SO_3$ and, therefore, we have developed special probes to measure the corrosion rate of low-temperature surfaces by flue gases. Concurrent with the tests at Mandalay, we plan to install these probes in both of the units at El Segundo to determine the difference in the corrosion rate of the test unit operating with two-stage combustion and the other unit, which is operated normally.

### Comment by A. C. Pasini[13]

This paper[11] reflects the spirit and approach to the solution of difficult and complex problems. It illustrates a willingness to spend money for research, even though in the minds of the technical personnel the research goes beyond what is warranted, because all utility managements do believe in being part of the community, sharing its problems, and contributing to the solution.

This spirit also poses a challenge to enforcement officials to justify their position of writing lawful requirements of performance, which are doubtful and possibly not in proper perspective with other air-pollution problems.

The magnitude of expense required to control emission of material leaving the stack based on our present knowledge of known methods is also illustrated. This poses an important consideration that caution and restraint should be exercised in setting performance standards and in enforcing these performance standards.

Research of great magnitude is needed to effect a break-through to reduce the enormous amount of money being spent today to eliminate air pollution. Much more co-operation and understanding by both industry and law enforcement authorities are needed so that the environment receives the most benefit for the least cost.

The authors are to be congratulated for their realistic approach toward the solution of a most complex situation facing all the people of this country.

### Comment by V. L. Stone[14]

The authors have given a fine summary of their efforts to reduce emission of air pollutants from effluents of Southern California Edison power-plant stacks. In the introduction to their paper, they also have given us an over-all picture of the sources of atmospheric contamination in the Los Angeles area. The research activities undertaken and completed by the utility industry should reflect favorably on their efforts.

The experiments in injecting $SO_3$ into natural-gas stack effluents were certainly interesting and, as far as I know, provide the first full-scale plant tests demonstrating quantitatively the effects of various $SO_3$ concentrations on plume opacity.

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[10] Field co-ordinator, Boiler Division, The Babcock & Wilcox Company, Barberton, Ohio. Mem. ASME

[11] H. C. Austin and W. L. Chadwick, "Control of Air Pollution From Oil-Burning Power Plants," MECHANICAL ENGINEERING, vol. 82, April, 1960, pp. 63–66.

[12] D. H. Barnhart and E. K. Diehl, "Control of Nitrogen Oxides in Boiler Flue Gases by Two-Stage Combustion," The Babcock & Wilcox Company, presented at the Meeting of the Air Pollution Control Association, Los Angeles, Calif., June 14, 1959.

[13] Assistant general superintendent of production, The Detroit Edison Company, Production Department, Detroit, Mich. Fellow ASME.

[14] Manager of power production, Operating Division, Commonwealth Edison Company, Chicago, Ill. Mem. ASME.

The effect of oil-ash on plume opacity was equally interesting. In the Windy City, the effluent from a fuel with the low ash content of fuel oil would not be a matter for great concern, although we are certainly interested in clean air.

The researches of Southern California Edison and the authors, in trying to find means to remove or reduce the sulfur content of the fuel, have been paralleled by us in our efforts to find ways to reduce the sulfur content of coal. A process was developed for reducing the sulfur content of coal by one half, but the economics of the process are not favorable.

Our studies on neutralizing sulfur oxides in stack gases with ammonia have confirmed the results obtained by the authors. $SO_3$ can be completely neutralized and removed at about 300 F, but $SO_2$ does not react with ammonia above a temperature of 120 F to form a solid which can be removed by a precipitator.

This low temperature (120 F) is below the water dew point, and reducing the entire volume of stack gas to this temperature would not be feasible. When we discovered this, it seemed that the only alternative was to convert the $SO_2$ to $SO_3$ by a catalytic process and then neutralize with ammonia, or remove it in an electrostatic precipitator. We learned that the authors, the EEI, and others were carrying on this work. Continuation of our research would, therefore, have been a duplication of effort.

The opacity of a plume from the stack of a coal-burning boiler is governed to a great extent by the efficiency of the electrostatic precipitator, and, as our recent work has shown, by the temperature of the gas entering the precipitator. We find that with the appreciable amount of fly ash present in burning coal, the fly-ash particles act as nuclei for precipitation of $SO_3$, and that both are almost completely removed if the temperature in the precipitator is in the vicinity of 300 F or lower. If our latest equipment is operating properly, little or no plume is visible even with operation of soot blowers. On our new electrostatic precipitators we secure 97 to 98 per cent efficiency without preliminary mechanical collectors.

The general impression, I think, has been that coal-burning boilers produce a lower concentration of NO than other fuels.

The authors, however, have shown that some of the highest concentrations are produced in coal-fired boilers.

Although we occasionally have smog in Chicago, it is not a pressing problem, and it occurs only on days when there is little or no air movement. For this reason, not much attention has been paid to NO production. Apparently, great progress has been made in solving the problem, both by the utility industry, and the authors' company in particular, and by the boiler manufacturers. I have not had an opportunity to fully study the boilers designed for the two-stage combustion which is reported to reduce NO formation, but I am wondering whether the design is such that it could be incorporated as more or less standard in coal-burning boilers without greatly increasing their cost.

It was interesting to learn from the paper that CO can be found in furnace gases even in the range of acceptable operating conditions. I would like to ask whether the authors think this would apply to coal-burning furnaces also.

It is appropriate that the authors should point out that there is no substantial evidence that either $SO_2$ or $SO_3$ in the concentrations ordinarily found in the atmosphere are harmful. The limits which have been established by responsible authorities for permissible concentrations under which men may work for protracted periods are much higher than those found in the ordinary city atmosphere under the most adverse conditions.

We should thank the authors for their contribution to research in Control of Air Pollution.

### Comment by G. V. Williamson[15]

The authors[11] and the firm with which they are associated deserve great commendation for the extraordinary efforts and most considerable success in reducing the discharge to the atmosphere in a major power plant near Los Angeles. The development in combustion, which indicates a reduction by 50 per cent of the nitrogen oxide released, is a truly major contribution in the Los Angeles situation. But it needs to be emphasized, however, that the power plants in the Los Angeles area have been a minor factor in the total air-pollution problem—as revealed by the data released by the Air Pollution District. Of great significance is the fact that the Ringelman Chart is being used solely for the purpose of measuring black smoke as a measure of stack opacity and a quality of plant performance from the viewpoint of air pollution. This can be nothing but a gross misapplication of the Ringelman Chart, and would seem to be an approach to a power-plant stack that is erroneous in the extreme. Clearly, if visual appearance is to be used as a measure of clean air performance, something besides the Ringelman Chart is needed.

This is a complicated problem because simple application involves the human factor, the color of the sky, and other uncontrollable variables. In the long run, control of air pollution will depend upon the proper application of proved measuring equipment, adapted to those pollutants known to be a nuisance. It would seem that in all three of these points use of the Ringelman Chart in measuring the oil plume from oil firing is a misapplication. Further, it should be given the greatest possible emphasis that approaches applicable or *perhaps* considered advisable for the Los Angeles area would have little merit in most communities in the rest of the nation. The Los Angeles situation is a special one, meteorologically and geographically. The most encouraging aspect of the situation is the apparent realization that autos, buses, and trucks, all of which are under the operation of a mass of individuals and not simply a single industry, are the heaviest single factor in a specific situation in that area.

### Authors' Closure

The authors appreciate the thoughtful and significant comments of each of the discussers.

The reduction in the formation of $SO_3$ through two-stage combustion, mentioned by Mr. Coykendall, does not seem to have been achieved. Recently completed tests, using both analytical methods and corrosion probes, show no significant difference in the $SO_3$ concentrations in the stack gases from conventionally fired and two-stage combustion boilers while burning similar fuel oil.

The authors have had no specific experience from which to answer Mr. Stone's question as to whether two-stage combustion could be incorporated successfully and economically into standard coal-burning boilers. However, a few tests on operating boilers should show whether this is practicable. Although the authors have no actual CO test data from coal-fired boiler operation, experiences with oil-burning units would lead to a surmise that comparatively low concentrations of CO might be found quite commonly in the stack discharge from coal-fired units that are fired well within the range of acceptable operating conditions.

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[15] Vice-president, Union Electric Company, St. Louis, Mo. Fellow ASME.

The authors appreciate fully that the air-pollution problems in the Los Angeles area differ in many ways, geographically, meteorologically, and politically from those in most other parts of the United States. However, the authors believe that, with time and observation, other communities will develop some of the same conditions which have become acute in Southern California. It is their hope that the experiences and research developments of industry can be of real value to the responsible citizens in other communities.

H. C. Austin.[16]
W. L. Chadwick.[17]

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[16] Southern California Edison Co., Los Angeles, Calif.

[17] Southern California Edison Co., Los Angeles, Calif. Mem. ASME.

## Materials Below −100 F

### Comment by J. W. Crossett[18]

THE author has done an excellent job of incorporating the wide variation of materials of construction used below −100 F into one paper.[19]

His discussion of the austenitic conversion which occurs in the 18/8 stainless steels, after prolonged exposure at low temperatures, is a phenomenon which is known to occur but has never caused any distress even in vessels operating many years at −454 F. Some time ago, some 3½, 9 per cent Nickel, and 18/8 stainless steels were impact tested using charpy keyhole bars after six months and 12 months at −320 F.

Bars of all of these materials were tested at room temperature and the 3½ per cent Nickel at −200 F, while the 9 per cent Nickel and stainless steels were run at −320 F.

Table 1 shows that the impact strength of all of these materials was higher at room temperature than when they were tested at the subzero temperature, but in all cases the extended exposure at the subzero temperature did not affect the toughness.

Extensive laboratory work has indicated that if the 9 per cent Nickel steel is double normalized and tempered prior to welding, it has excellent toughness in the as-welded condition even down to −320 F as shown in Table 2. It is believed that sufficient laboratory data have been presented to establish this and a large-sized pressure-vessel test is being planned to demonstrate that it is safe to use 9 per cent Nickel steel in the as-welded condition down to −320 F.

### Comment by T. E. Eagan[20]

A tremendous amount of work has been done on the physical properties of metals at very low temperatures. The author of this paper[19] has done a fine job of condensing this information and of putting it into a usable form. I congratulate him.

In the use of metals at low temperatures we sometimes have the tendency to look at impact resistance as the only criterion for the acceptance of any given metal. However, many pieces of machinery are used at low temperatures which are not subject to impact; thus low impact materials can be used safely. A good example of this is brought out by the author in explaining the use of cast iron for low-temperature applications.

Gray iron is not a brittle material in the strict sense of our interpretation of brittleness. It has low ductility which is a somewhat different thing. As the author points out, it loses some of this ductility as the temperature is lowered. It also has low notch sensitivity in fatigue which it does not lose. Thus advantage can be taken of these conditions and this so-called brittle material can be used successfully in properly designed components. In other words, if we start out with a serviceable design using gray iron at room temperature, recognizing its limitations, we can expect to have a serviceable material at lower temperatures. I know of compressors made of good quality gray iron which have operated for many years at −320 F.

I believe that the proper use of such materials is of fundamental importance because we can produce castings to the desired shape much easier in gray iron than we can make them in the austenitic or face-centered crystalline materials. Another point is that these materials cost considerably less.

I would like to point out, however, that it is not good enough to call just for gray iron, or nickel containing gray iron, or for so-called semisteel. Gray iron today is produced with tensile strengths anywhere between 20,000 psi and 60,000 psi. ASTM specification A-48 recognizes seven different grades based on 5000 psi increments between these two extremes. The proper grade for the stress operating level should be specified.

The increases in volume when gray iron is used, mentioned by the author, can be explained by the fact that most high-grade irons always have small amounts of retained austenite in them which transforms at the low tempera-

**Table 1 Charpy Impact, Ft Lb—Before and After Exposure to Liquid Nitrogen**

| Conditions | | Steels | | |
|---|---|---|---|---|
| | | 3½% Nickel | 8½% Nickel | 18-8 |
| Tested at 70 F | No aging, no chilling ....... | 60, 57 | 50, 51 | 80, 90 |
| | No aging, chilled −320 F.... | 57, 59 | 43, 44 | 90, 91 |
| | Aged 6 mos. at 70 F., no chilling .................. | 56, 62 | 53, 50 | 96, 97 |
| | Aged 6 mos. at −320 F....... | 59, 60 | 42, 43 | 91, 83 |
| | Aged 12 mos. at 70 F, no chilling .................. | 63, 56 | 50, 52 | 93, 92 |
| | Aged 12 mos. at −320 F...... | 57, 58 | 44, 43 | 89, 83 |
| | | Tested at −200 F | | |
| Tested at −320 F | No aging .................. | 11, 13[a] | 25, 24 | 72, 73 |
| | Aged at −320 F, 6 mos....... | 15, 22, 13[a] | 26, 22, 24 | 72, 74 ,75 |
| | Aged at −320 F, 12 mos...... | 13, 21, 21[a] | 23, 23, 23 | 73, 77, 74 |

[a] Tested at −200 F.

**Table 2 Charpy Impact, Ft Lb of Welded Specimens**

| Conditions | | Material | | |
|---|---|---|---|---|
| | | 8½% Nickel welded with 25-20, notched in weld | 8½% Nickel welded with 25-20, notched in fusion zone | 18-8 welded with 18-8, notched in weld |
| Tested at 70 F | No aging, no chilling ....... | 24, 25 | 28, 39 | 28, 28 |
| | No aging, chilled −320 F.... | 27, 30 | 53, 31 | 31, 33 |
| | Aged 6 mos. at 70 F, no chilling .................. | 31, 29 | 36, 50 | 26, 23 |
| | Aged 6 mos. at −320 F....... | 25, 30 | 50, 29 | 35, 26 |
| | Aged 12 mos. at 70 F, no chilling .................. | 24, 28 | 46, 42 | 35, 31 |
| | Aged 12 mos. at −320 F...... | 28, 33 | 35, 40 | 28, 29 |
| Tested at −320 F | No aging .................. | 26, 19, 27 | 22, 30, 28 | 18, 18 |
| | Aged −320 F, 6 mos........ | 20, 16, 17 | 28, 20, 32 | 22, 22, 17 |
| | Aged −320 F, 12 mos....... | 27, 21, 18 | 26, 27, 24 | 22, 19, 17 |

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[18] J. W. Crossett, The International Nickel Company, Inc., New York, N.Y.

[19] O. A. Hansen, "Materials Below—100 F," MECHANICAL ENGINEERING, vol. 82, April, 1960, pp. 60–62.

[20] Chief research metallurgist, The Cooper-Bessemer Corporation, Mount Vernon, Ohio, and Grove City, Pa.

tures causing an increase in volume. It can be eliminated if necessary by stress relieving the castings at 1050 F.

### Comment by J. E. Jensen[21]

The author of this paper[19] is to be commended for a quite thorough presentation of a rather complicated subject. The points he has covered, such as change of ductility, improper heat-treatment, and problems of joining are of basic importance and cannot be overstressed. In the interest of clarity, a figure showing the trend of tensile and yield strengths versus reduction in temperature, of the various materials discussed, would be helpful. Also a list of references would be useful to anyone wishing to pursue the subject further.

One property, which is of great importance in the cryogenic field, that the author failed to cover, was that of thermal conductivity. The thermal conductivity of the materials discussed are, in general, decreased by lowering the temperature; the exceptions are the pure forms of copper and aluminum which increase to a high at from $-390$ F to $-440$ F and then decrease rapidly to about the same value as ambient temperature figures when liquid helium temperature is reached. The proper selection of materials with regard to their thermal characteristics adds another problem to the use of materials in cryogenic applications. Mechanically sound design with a given material may be easily fabricated and structurally safe, while at the same time operationally extravagant.

### Author's Closure

The author thanks the reviewers for their comments on this paper.

The elimination of postheat-treatment in welded pressure vessels made of 9 per cent nickel steel, as suggested by Mr. Crossett, will broaden the field for this material. Until this is cleared through a revision of the Code, however, it will be necessary to postheat-treat for Code approval.

Mr. Eagan's comments regarding the adaptability of cast iron for low-temperature service are substantiated by our own practice. The ease of making intricate castings in small volume is offset to some extent by the need for heavy sections, but this is generally not serious except for equipment which must be cooled down and warmed up at frequent intervals.

The thermal conductivity of materials is important, as Mr. Jensen points out. In special cases, this applies to a small temperature difference at some nominal low value, but generally the over-all conductivity from a low temperature to ambient is the controlling factor, and the average for the whole range is used. Data regarding thermal conductivity at cryogenic temperatures are only recently being published, the best collection being the Cryogenic Data Book issued by the National Bureau of Standards.

**O. A. Hansen.**[22]

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[21] Mechanical engineer, Brookhaven National Laboratory, Upton, N. Y. Mem. ASME.

[22] Engineering consultant, Linde Company, Division of Union Carbide Corporation, Tonawanda, N. Y.

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## BOOKS RECEIVED IN LIBRARY

### Elevators

By F. A. Annett. Third Edition. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 388 p., $6\frac{1}{4} \times 9\frac{1}{4}$ in., bound. $11.50. Comprehensive and practical information on the construction, operation, and maintenance of vertical transportation equipment in public and private structures, for maintenance men, mechanics, engineers, and others concerned with elevators, escalators, moving sidewalks, and ramps. Topics covered include a-c, d-c, and electrohydraulic machinery, methods of roping, signals, and safety systems. New material includes conformity with 1955 ASA standards, and electronic and automatic innovations.

### Etudes de Pyrometrie Pratique

By R. Allègre and others. 1959, Èditions Eyrolles, Paris, France. 231 p., $6\frac{1}{2} \times 9\frac{3}{4}$ in., bound. 3440 Francs. This collection of papers emphasizes the practical application and current practice in temperature measurement. A general survey of pyrometric theory and techniques, giving factors for selection of methods in specific applications, is followed by more detailed studies of particular methods. Included are papers on the use in temperature measurement of thermally sensitive resistors ("thermistances"), thermocouples, and optical techniques. These last are specifically applied in flame-temperature measurements and employ photoelectric and suction pyrometers.

### Handbook of Material Trade Names, Supplement 3 to the 1953 Edition

By O. T. Zimmerman and Irvin Lavine. 1960, Industrial Research Service, Inc., Dover, N. H. 400 p., $7\frac{1}{2} \times 10\frac{1}{2}$ in., bound. $16. Supplements the 1953 edition and its first two supplements by giving completely new information in five sections as follows: Alphabetical list of trade names, with description of the product; products classified by major uses or composition; list of manufacturers and distributors, giving addresses and names of products; company name and address changes for those companies listed in the 1953 edition and supplements 1 and 2; and products previously listed which have been withdrawn from the market. Symbols indicate trademarks registered in the United States, Canada, Germany, and Great Britain, and also unregistered and common names.

### Heizöl—Handbuch für Industriefeuerungen

By Werner Hansen. 1959, Springer-Verlag, Berlin, Germany. 369 p., $6\frac{1}{2} \times 9\frac{1}{4}$ in., bound. 31.50 DM. A fuel oil handbook for industrial heating installations. It summarizes experience and the present state of knowledge and research. It also gives examples from various industries to show how fuel oil is to be used. Section A covers sources, properties, standardization, combustion, heat transfer, heat loss and recuperation, corrosion, flue gas damage, etc. Section B discusses various applications: for the ordinary steam boiler; the pulverized-coal boiler; furnaces for ceramics, bricks, glass, etc. There is a list of references arranged by chapters.

### Hütte; Mathematische Formeln und Tafeln

By I. Szabó. 1959, Wilhelm Ernst & Sohn, Berlin, Germany. 287 p., $6 \times 8\frac{1}{4}$ in., bound. DM 19.80. Starting with relatively simple mathematical operations, this collection of mathematical tables and formulas covers a wide range of topics up through advanced calculus. The first chapter contains the tabular material ranging from powers, reciprocals, etc., to elliptic integrals and Bessell functions. The following chapters deal, respectively, with the common divisions of mathematics, including explanatory text as well as formulas. A concluding section provides brief examples of "practical mathematics."

### Industrial Minerals and Rocks (Nonmetallics Other Than Fuels)

Edited by Joseph L. Gillson and others. Third Edition. 1960, The American Institute of Mining, Metallurgical, and Petroleum Engineers, 29 West 39th Street, New York 18, New York. 934 p., $7\frac{1}{4} \times 10\frac{1}{4}$ in., bound. $12. This new edition of a standard reference book includes information of value to chemical, civil, electrical, and mechanical engineers as well as to those in the mineral extracting and processing industries. Thoroughly rewritten to include developments since the second edition, 1949, the book covers all known useful minerals and rocks: abrasives, carbonate rocks, cement materials, dimension stone, pigments, quartz crystal, roofing granules, titanium, zirconium, etc. Each of the 55 chapters is prepared by specialists in the mineral covered and gives extensive data on geology, deposits, prospecting, preparation, marketing, prices, and uses. Chapter bibliographies and a detailed subject index add to the reference value of the book.

### Industrial Packaging

By Walter F. Friedman and Jerome K. Kipnees. 1960, John Wiley & Sons, Inc., New York, N. Y. 536 p., $6 \times 9\frac{1}{2}$ in., bound. $11.50. This survey of packaging materials, methods, and equipment emphasizes basic principles applicable to all package-using industries and gives an economic analysis of the field. It also cites case histories in the development of an optimum total packaging system for any business.

## LIBRARY SERVICES

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### International Symposium on the Theory of Switching, Proceedings, 1957

Published 1959 by the Harvard University Press, Cambridge, Mass. 2 volumes, 8 × 10¾ in., bound. $15. An extensive presentation of various important aspects in the development of switches, switching theory, and applications since the advent of large-scale digital computers. The 39 papers published in these two volumes deal with abstract models of mathematical and logical theory; contact networks and network theory; magnetic and transistor logic, design, and circuit considerations; switching systems and networks; and new types of switches such as the cryotron and chemical switching methods. They include developments in foreign countries as well as in the United States. These are volumes 29 and 30 of the Annals of the Computation Laboratory.

### Jahrbuch der Oberflachentechnik 1960

Edited by W. Wiederholt. 1959, Metall-Verlag GmbH., Berlin-Grunewald, Germany. 1076 p., 4¼ × 5¾ in., bound. DM 22.50. This annual volume presents the latest information available in the technical and patent literature of Germany and other countries concerning the mechanical, chemical, and electrochemical treatment of metal surfaces. In addition to survey articles by specialists on various phases of metal-surface treatment, the book contains new data tables, extensive alphabetical or classified listings of trade names, standards, and manufacturers, and other useful information.

### Jahrbuch 1958 der Wissenschaftlichen Gesellschaft fuer Luftfahrt E.V.

Edited by Hermann Blenk. 1959, Friedr. Vieweg & Sohn, Braunschweig, Germany. 300 p., 8½ × 11¾ in., bound. No price given. This Yearbook for 1958 by the German Scientific Society for Aeronautics includes some 49 papers presented at the Annual Meeting of the Society. Sample topics are: Airfoil wings at subsonic velocity; pulsations of shock-diffusers; special convection currents; trajectory-measuring processes; launching of large missiles; new methods for improving bad-weather approach through optical landing devices, etc.

### Liquids and Liquid Mixtures

By J. S. Rowlinson. 1959, Academic Press, Inc., New York, N. Y. 360 p., 5½ × 8¾ in., bound. $12.50. The equilibrium properties, and development of new methods for calculating the thermodynamic properties, of pure liquids, and the equilibrium properties of liquid mixtures, are discussed in the first two sections of this book. The final section is an account of the theories of liquids and mixtures, developing those parts of statistical thermodynamics common to all theories, and then restricting the account to results that can be compared directly with experiment.

### Nuclear Power Plant

By E. Openshaw Taylor. 1959, Philosophical Library, Inc., New York, N. Y. 184 p., 5½ × 8¾ in., bound. $7.50. A review of the basic ideas underlying nuclear power generation for the informed reader. It opens with a concise account of world energy requirements and resources in the present and in the future. It goes on to deal with nuclear and reactor physics and reactions, types of reactor according to different means of classification, reactor engineering based on the unique reactor physics, the control of the heat output of the reactor, instrumentation, and economics of nuclear stations. The appendixes contain comprehensive tables of elements, neutron interaction formulas, reactor theory, and a chronology of nuclear power development.

### Oil Hydraulic Power and Its Industrial Applications

By Walter Ernst. Second Edition. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 467 p., 6¼ × 9¼ in., bound. $12.50. The fundamental concepts of fluid mechanics and fluid theory are covered briefly but thoroughly in the opening chapters, followed by application of these concepts to oil under pressure in the generation, utilization, transmission, control, and applications of oil hydraulic power. Fully revised and incorporating such recommendations as the Joint Industry Conference Standards, this edition also contains new material in such fields as synthetic hydraulic fluids, pump control, noise and vibration in pumps, and servomechanisms and valves.

### Petroleum Products Handbook

Edited by Virgil B. Guthrie. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. Various pagings, 6 × 9¼ in., bound. $18.50. The properties, characteristics, manufacture, marketing, and performance of such petroleum products as gasolines, diesel fuel oils, lubricating oils and greases, aircraft fuels, petrochemicals, and many others, have been compiled by 32 specialists in this closely-indexed comprehensive handbook. There are also sections on crude petroleum and natural gas, additives, units of measurement, and a special "Reference Data Section" which includes indexes to information sources, ASTM test methods and specifications, Federal specifications, industry terminology, tax and price statistics, and a directory of United States refineries.

### Principles of Engineering Economy

By Eugene L. Grant and W. Grant Ireson. Fourth Edition. 1960, The Ronald Press Company, New York, N. Y. 574 p., 6¼ × 9¼ in., bound. $8. Using the method of comparison of alternatives, this book is intended to serve both as a textbook and a working manual for those who make decisions about investments in capital goods. It gives basic principles for making practical decisions on the acquisition and retirement of capital goods, the choice of one of alternative methods of financing, and the consideration of income tax factors. Special attention is paid to capital rationing, mathematical analysis of compound interest, and operations research concepts. Features new to this edition include cash flow theory, various depreciation methods under U. S. tax laws, and certain unsound criteria to avoid in evaluating investment proposals.

### Science and Resources

Edited by Henry Jarrett. 1959, The Johns Hopkins Press, Homewood, Baltimore, Md. 250 p., 6¼ × 9¼ in., bound. $5. Some of the difficult and critical questions arising from recent advances in science and technology are explored in this collection of papers originally presented at the 1959 Washington "Resources for the Future" Forum. A lead essay in each of the six topical sections discusses advances and state of current knowledge in a specific field and is followed by two essays discussing the economic, social, and political impact of the advances. The six sections deal with human and animal genetics, weather control, geological exploration, chemical technology, nuclear energy and peaceful use of atomic energy, and space exploration.

## ASME BOILER AND PRESSURE VESSEL CODE

### Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

(The following Case Interpretations were formulated at the Committee meeting April 29, 1960, and approved by the board on June 23, 1960.)

### Annulment of Cases
### Case 1263

Essence of Case included under Par. P-242 of the 1959 Winter Addenda to Section I.

### Case 1273N-2

*(Special Ruling)*

### Nuclear Reactor Vessels and Primary Vessels

Revise the second sentence of Par. 5(d) of the Reply to read: Non-full-penetration welds are allowed only for attachments on which there are no piping reactions, such as control-rod housings, pressurizer heater attachments, and openings for instrumentation, and on which there will be no thermal stresses higher than expected in the vessel itself. For such attachments, all compensation shall be inherent in the part of the vessel penetrated. Non-full-penetration welds shall be of sufficient size to develop the full strength of the attachment.

## Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As need arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the semi-annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

### Power Boilers, 1959

Par. P-4

Revise to read:

Braces fabricated by forge welding shall comply with Specification SA-84, staybolt wrought iron, solid.

Pars. P-6 and P-7

Delete present Pars. P-6 and P-7 and replace with the following:

Par. P-6(a) Threaded staybolts shall be of iron complying with SA-84, or of steel complying with Specification SA-31; or of annealed nickel-copper alloy complying with Specification SB-164.

Par. P-6(b) Seamless steel tubes for threaded staybolts shall comply with Specification SA-83, Type A; SA-192; or SA-210.

Par. P-6(c) Stays, through rods, or braces with pads or crowfeet; for attachment by riveting shall comply with Specifications SA-7, SA-31, SA-84, SA-306 Grades 50, 55, or 60, or SB-164.

Par. P-6(d) Staybolts, stays, through rods, or braces with ends for attachment by fusion welding shall comply with Specification SA-31, SA-84, or SA-306 Grades 50, 55, or 60.

Par. P-200(c)(8)

Delete present paragraph and renumber present (c)(9), (10), (11), and (12) to read: (c)(8), (9), (10) and (11).

Table P-7 Pipes and Tubes, Seamless Alloy Steel, delete reference to SA-335, Grade P3b.

### Unfired Pressure Vessels, 1959 Proposed Rules for Reducers

Par. UG-32(g)

Revise reference to Par. UA-4(f) to read:

Par. UA-5(b) and (c).

Par. UG-36(b)(2)

Revise to read:

Properly reinforced openings in formed heads need not be limited as to size, but, when the opening in the end closure of a cylinder is larger than one half the inside diameter of the shell, it is recommended that the closure be made by a reversed-curve section as shown in sketches (c) and (d) in Fig. UG-36, or by a conical section or a cone with a knuckle radius at the large end as shown in sketches (a) and (b) of Fig. UG-36 and/or with a flare radius at the small end. The design shall comply with all the requirements of the rules for reducer sections (see Par. (e)) in so far as these rules are applicable.

Fig. UG-36

Delete the first sketch from the left and label the remaining two sketches as (c) and (d), respectively, and add the two new sketches (a) and (b).

Par. UG-36(e)

Add the following new paragraph:

*UG-36(e) Reducer Sections Under Internal Pressure* (1) The formulas and rules of this paragraph apply to concentric reducer sections wherein all the longitudinal loads are transmitted wholly through the shell of the reducer. Where loads are transmitted in part or as a whole by other elements, e.g. inner shells, stays, or tubes, the rules of this paragraph do not apply.

(2) The thickness of each element of a reducer, as defined in (4) below, under internal pressure shall not be less than that computed by the applicable formula. In addition, provisions shall be made for any of the other loadings listed in Par. UG-22, when such loadings are expected.

(3) The notations defined in either Par. UG-32(c) or below are used in this paragraph (See Fig. UG-36).

$t$ = minimum required thickness of the considered element of a reducer after forming, exclusive of corrosion allowance, inches,

$R_L$ = inside radius of larger cylinder, inches,

$R_s$ = inside radius of smaller cylinder, inches,

$r_L$ = inside radius of knuckle at larger cylinder, inches,

$\alpha$ = one half of the included (apex) angle of a conical element, degrees.

(4) *Elements of a Reducer* A transition section reducer consisting of one or more elements may be used to join two cylindrical shell sections of different diameters but with a common axis provided the requirements of this paragraph are met:

(a) *Conical Shell Section* The required thickness of a conical shell section, or the allowable working pressure for such a section of given thickness, shall be determined by the formulas given in Par. UG-32(g).

(b) *Knuckle Tangent to the Larger Cylinder* Where a knuckle is used at the large end of a reducer section, its shape shall be that of a portion of an ellipsoidal, hemispherical, or torispherical head. The thickness and other dimensions shall satisfy the requirements of the appropriate formulas and provisions of Par. UG-32.

(5) *Combination of Elements to Form a Reducer* When elements of subsection (4), above, having different thicknesses are combined to form a reducer, the joints including the plate taper required by Par. UW-9(c) shall lie entirely within the limits of the thinner element being joined.

(a) A reducer may be a simple conical shell section, Fig. UG-36(a), without knuckle, provided the half-apex angle $\alpha$ is not greater than 30 degrees, except as provided for in Par. UA-5(e). A reinforcement ring shall be provided at either or both ends of the reducer when required by the rules of Par. UA-5.

(b) A toriconical reducer, Fig. UG-36(b), may be shaped as a portion of a toriconical head, Par. UG-32(h), a portion of a hemispherical plus a conical section, or a portion of an ellipsoidal head plus a conical section, provided the half-apex angle $\alpha$ is not greater than 30 degrees, except as provided for in Par. UA-5(e). A reinforcement ring shall be provided at the small end of the conical reducer element when required by the rules in Par. UA-5.

(c) Elements of shapes other than those of subsection (4) above shall be covered by the rules in this Par. UG-36.

Par. UG-37(a)

Revise to read:

UG-37(a) General—The rules of this paragraph apply to all openings other than:

(1) Small openings covered by Par. UG-36(c)(3),

(2) Openings in flat heads covered by Par. UG-39,

(3) Openings designed as reducer sections covered by Par. UG-36(e),

(4) Large head openings covered by Par. UG-36(b)(2).

Reinforcement shall be provided in amount and distribution such that the area requirements for reinforcement are satisfied for all planes through the center of the opening and normal to the vessel surface. For a circular opening in a cylindrical shell, the plane containing the axis of the shell is the plane of greatest loading due to pressure.

Par. UA-4(f)

Delete this paragraph after transferring the examples contained therein as explained under new Par. UA-5(f).

Par. UA-5

Add the following new paragraph:

UA-5 Rules for Reducer Sections and Conical Heads Under Internal Pressure

(a) The formulas of this paragraph provide for the design of reinforcement at the cone-to-cylinder junction for reducer sections and conical heads where all the elements have a common axis.

The notations defined below are used in the formulas of the following subparagraphs:

$t$ = minimum required thickness of cylinder at cone-to-cylinder junction exclusive of corrosion allowance (See Par. UG-27-(c)), inches,

$t_s$ = nominal thickness of cylinder at cone-to-cylinder junction, exclusive of corrosion allowance (See Par. UG-25), inches,

$t_c$ = nominal thickness of cone at cone-to-cylinder junction, exclusive of corrosion allowance (See Par. UG-25), inches,

$t_e$ = the smaller of $(t_s - t)$ or $[t_c - (t/\cos\alpha)]$, inches,

$R_s$ = inside radius of small cylinder, inches,

$R_L$ = inside radius of large cylinder, inches,

$A$ = required area of reinforcement, square inches,

$A_e$ = effective area of reinforcement due to excess metal thickness, square inches,

$\Delta$ = maximum half-apex angle for an unreinforced cone-to-cylinder junction, degrees, see Tables UA-5.1 and UA-5.2,

$m$ = the smaller of $\left[\frac{t_s}{t}\cos(\alpha - \Delta)\right]$ or $\left[\frac{t_c \cos\alpha \cos(\alpha - \Delta)}{t}\right]$

$E$ = lowest efficiency of the longitudinal joint in the shell or head or of the joint in the reinforcement ring. For the large end of the reducer in compression E = 1 for butt welds.

$P$, $S$ and $\alpha$ are as defined in Par. UA-4(b).

(b) Conical heads and reducers without knuckles, having values of $\alpha$ exceeding the value of $\Delta$ obtained from Table UA-5.1, shall be provided with a reinforcement ring at the junction with the large cylinder.

**Table UA-5.1 Values of Δ for Junctions at the Large Cylinder**

| P/SE | 0.001 | 0.002 | 0.003 | 0.004 | 0.005 |
|---|---|---|---|---|---|
| Δ, deg | 11 | 15 | 18 | 21 | 23 |
| P/SE | 0.006 | 0.007 | 0.008 | 0.009 | |
| Δ, deg | 25 | 27 | 28.5 | 30 | |

The cross-sectional area of the reinforcement ring shall be at least equal to that indicated by the following formula:

$$A = \frac{PR_L^2}{2SE}\left(1 - \frac{\Delta}{\alpha}\right)\tan\alpha \qquad (1)$$

When the thickness, less corrosion allowance, of both the reducer and cylinder exceeds that required by the applicable design formulas, the minimum excess thickness may be considered to contribute to the required reinforcement ring in accordance with the following formula:

$$A = 4\,t_e\sqrt{R_L t_s} \qquad (2)$$

Any additional area of reinforcement which is required shall be situated within a distance of $\sqrt{R_L t_s}$ from the junction of the reducer and the cylinder. The centroid of the added area shall be within a distance of $0.5\sqrt{R_L t_s}$ from the junction.

(c) Reducers having values of $\alpha$ exceeding the value of $\Delta$ obtained from Table UA-5.2 shall be provided with a reinforcement ring at the junction with the small cylinder.

**Table UA-5.2 Values of Δ for Junctions at the Small Cylinder**

| P/SE | 0.002 | 0.005 | 0.010 | 0.02 |
|---|---|---|---|---|
| Δ, deg | 4 | 6 | 9 | 12.5 |
| P/SE | 0.04 | 0.08 | 0.10 | 0.125 |
| Δ,deg | 17.5 | 24 | 27 | 30 |

The cross-sectional area of the reinforcement ring shall be at least equal to that indicated by the following formula:

$$A = \frac{PR_s^2}{2SE}\left(1 - \frac{\Delta}{\alpha}\right)\tan\alpha \qquad (3)$$

When the thickness, less corrosion allowance, of either the reducer or cylinder exceeds that required by the applicable design formula, the excess thickness may be considered to contribute to the required reinforcement ring in accordance with the following formula:

$$A_e = m\sqrt{R_s t}\,\{(t_c - t/\cos\alpha) + (t_s - t)\} \qquad (4)$$

Any additional area of reinforcement which is required shall be situated within a distance of $\sqrt{R_s t_s}$ from the junction, and the centroid of the added area shall be within a distance of $0.5\sqrt{R_s t_s}$ from the junction.

(d) Reducers not described in Par. UG-36(e)(5), such as those made up of two or more conical frustums having different slopes, may be designed in accordance with subsection (e).

(e) When the half-apex angle $\alpha$ is greater than 30 deg, an analysis based on methods, such as that of Geckeler, may be used. See Par. U-2(c). When such an analysis is made, the calculated localized stresses at the discontinuity shall not exceed the following values:

(1) (membrane hoop stress) + (average discontinuity loop stress) shall not be greater than $1^1/_2$ SE,

(2) (membrane longitudinal stress) + (discontinuity longitudinal stress due to bending) shall not be greater than 4SE,

where the "average discontinuity hoop stress" is the average hoop stress across the wall thickness due to the discontinuity at the junction, disregarding the effect of Poisson's ratio times the longitudinal stress at the surfaces.

(f) *Example 1:* Add example (1) showd in Par. UA-4(f) except after the words "substituting in equation (5)," add the words: Par. UA-4(e).

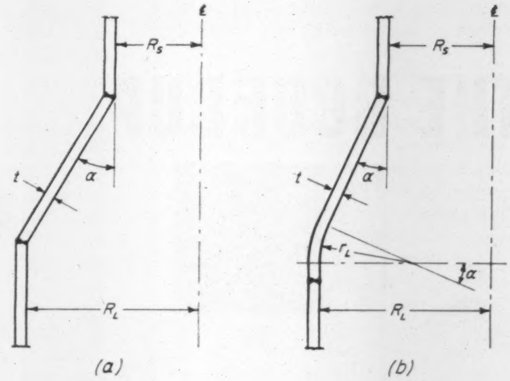
*Example 2:* A compression ring is to be used at the junction of conical head and shell of Example 1. Determine the required area of the compression ring. E = 1 (see Par. UA-5(a)).

$$\frac{P}{SE} = \frac{50}{13750 \times 1.00} = 0.0036$$

Entering Table UA-5.1, we find $\Delta = 19.8$. Since $\alpha$ exceeds $\Delta$, a compression ring is required.

Area required in compression ring, from Equation (1):

$$A = \frac{50(100)^2}{2(13750 \times 1.0)}\left(1 - \frac{19.8}{30}\right)0.577 = 3.55 \text{ sq in.}$$



Sketches
(a) and (b)
to be added tp
Fig. UG-36

*Example* 3: Add Example (3) shown in Par. UA-4(f) except revise "using formula (3) in (d)" to read: using formulas (3) in Par. UA-4(d).

PAR. UG-28(f)

Revise the note under the paragraph to read:

Except as covered in Pars. UCS-66(c)-(2) and UHA-51(b), a vessel which is designed and constructed to Code requirements for internal pressure and which may at times be subjected to an external pressure of 15 psi or less need not be constructed to Code requirements for the external pressure condition. Such a vessel may bear the Code symbol for the internal pressure condition.

PAR. UG-116(b)

Revise to read:

Vessels designed to operate at temperatures below minus 20 F shall be marked as required by the other sections of this paragraph except for the following:

(1) When impact tests in accordance with Par. UG-84 are required:

(a) Replace item (4) in (a) with "Allowable temperature range," giving both minimum and maximum temperatures for which the vessel is suitable:

(b) Add the initials I T after the figures for the minimum temperature when the material in the vessel has passed the impact tests required under the provisions of Par. UG-84.

(2) When in accordance with Par. UCS-66(c)(2) or UHA-51(b) no impact test is performed, the vessel shall be marked as required by other sections of this paragraph for the maximum design pressure for coincident temperatures of minus 20F and above and in addition shall be marked for the operating pressure (prior to multiplying by two and one-half to obtain the design pressure) at the lowest coincident temperature below minus 20 F, such marking to be followed by the lettering UCS-66 or UHA-51.

PAR. UF-47

Revise to read:

Parts-Forgings (a) When welding is used in the fabrication of parts-forgings completed elsewhere, the parts-forgings manufacturer shall furnish a partial data report Form U-2.

(b) All parts-forgings completed elsewhere shall be marked with the manufacturer's name and the forging identification, including material designation. Should identifying marks be obliterated in the fabrication process and for small parts, other means of identification shall be used. The forging manufacturer shall furnish reports of chemical and mechanical properties of the material and certification that each forging conforms to all requirements of Part UF.

(c) Welded repairs to parts-forgings completed elsewhere need not be inspected by an authorized inspector at the plant of the forging manufacturer, but the manufacturer shall furnish a report of the extent and location of such repairs together with certification that they were made in accordance with all other requirements of Pars. UF-37 and UF-38. If desired, welding repairs of forgings made elsewhere may be made, inspected, and tested at the shop of the pressure vessel manufacturer.

PAR. UF-115

Add the following:

All data reports shall show the heat number or numbers and ladle analysis of the metal in the ingot from which the vessel was forged, the test results obtained for the forging, and the dimensions of the forged vessel.

PAR. UF-120

Delete this paragraph.

TABLE UCS-23, Bolting, Low-Alloy Steels, delete reference to SA-193, Grade B7a, Pipes and Tubes, Seamless Low-Alloy Steels, delete reference to SA-335, Grades P3 and P3b.

PAR. UCS-66(c)(2)

Revise to read:

No impact test is required for materials used in fabricating a vessel for metal temperatures below minus 20 F when the minimum thickness is the greater of those determined under the most severe condition of coincident pressure (external or internal) and temperature in accordance with Par. UG-21 for temperatures of: (a) minus 20 F and above, and (b) below minus 20 F in which case the coincident pressure (internal if above atmospheric and external if below atmospheric) shall be multiplied by two and one half.

PAR. UHA-51(b)

Revise the first paragraph to read:

For the following materials operating at a metal temperature below minus 20 F except when the minimum thickness is the greater of those determined under the most severe condition of coincident pressure (external or internal) and temperature in accordance with Par. UG-21 for temperatures of (a) minus 20 F and above, and (b) below minus 20 F in which case the coincident pressure (internal if above atmospheric and external if below atmospheric) shall be multiplied by two and one half.

TABLE UHA-23

Under notes for Spec. SA-351, Grades CF-8, CF-8M, and CF-8C revise Note (10) to read: (11) and add an explanation of Note (11) to read: (11) For temperatures above 800 F, the stress values apply only when the carbon content is 0.04 per cent and above.

Bolting, delete reference to SA-193, Grades B8D and B8F.

### Welding Qualifications, 1959

PAR. Q-24(c) and QN-24(c)

Delete last two sentences as shown in the August 24, 1959, Addenda.

PAR. Q-3(5)(b) and QN-3(5)(b)

Revise the second sentence to read:

Qualification in the horizontal fixed position, 5G, shall qualify for the flat, vertical, and overhead positions.

PAR. Q-23(e)(4)

Revise to read:

Welders who qualify on carbon steel test plates using F-4 electrodes of the SA-233 classification are also qualified to weld using alloy steel electrodes of a comparable or lower F-number within the 6 per cent total alloy content limitation.

Current
Engineering
Events, News, and
Comment

E. S. NEWMAN
News Editor

# THE ROUNDUP

Andrew Fletcher, **left,** President of United Engineering Trustees; former President Herbert Hoover, **center;** and Mayor Robert Wagner of New York City take part in cornerstone-setting ceremony for United Engineering Center

## United Engineering Center Cornerstone Set

### Mayor Wagner and Former President Hoover Officiate at Ceremonies

"THE cornerstone and the keystone are the familiar emblems or benchmark ... of the professional engineer in the design of buildings and bridges. We have learned to place our faith in the cornerstone as well as in the keystone in recognition of the dedication that engineers have offered to our progress and to our very way of life. Indeed, without engineers to regulate our rapid pace of modern times, we would have chaos."

So said New York City's Mayor Robert F. Wagner at the cornerstone laying ceremonies of the new United Engineering Center on June 16, 1960.

As part of the ceremony former President Herbert Hoover read "a message for posterity" which he prepared for inclusion in the cornerstone vault—a copper box which will also house such documents as the annual reports of the occupants, constitutions, various journals, brochures, commemorative booklets, and the like.

Mr. Hoover's message said in part: "During the last century our profession of engineering has advanced from the status of a trade to a great profession ranking with all other great professions. And with the training required for an engineer a great contribution for the future has come to the world. The very nature of training for our profession demands intellectual integrity and minds to whom truth has become an instinct. The leaven of this sort of mind will contribute to continuing progress in the free world.

"We can be sure that scientific discovery and invention will produce many changes in life, will impose new economic and social changes, and will necessitate changes in the methods of government in this next century.

"But civilization is faced with a major danger. At least 600,000,000 people have adopted Communism which denies religious faith, which finds its inspiration in rank materialism and whose primary tenet is that, by conspiracy or military action, freedom will be extinguished in the world.

"Within all the problems of the free governments and of international life there are stabilizing forces. Religious faith, its inspiration to moral virtues, and the unextinguishable spark in man to be free may well be the salvation of progress and civilization. We can at least bid our successors to make sure these forces live."

When it is completed in mid-1961, the stainless-steel and glass structure at 47th

Street and United Nations Plaza will house 18 groups devoted to the advancement of the engineering profession. Together, the groups represent more than 250,000 members.

"In dedicating this cornerstone," Mayor Wagner said, "we can contemplate the power, the integrity, and the precision which dictates the determination of professionally trained engineers, and we can afford to feel confident that our best interests are their primary concern.

"Industry and education, as well as engineers, have contributed toward the United Engineering Center and we may be certain that the seed of truth thus spread will take root and produce a hundredfold, thus bringing benefit to industry, advancement to education, and gratification to individual engineers as well as their respective Societies.

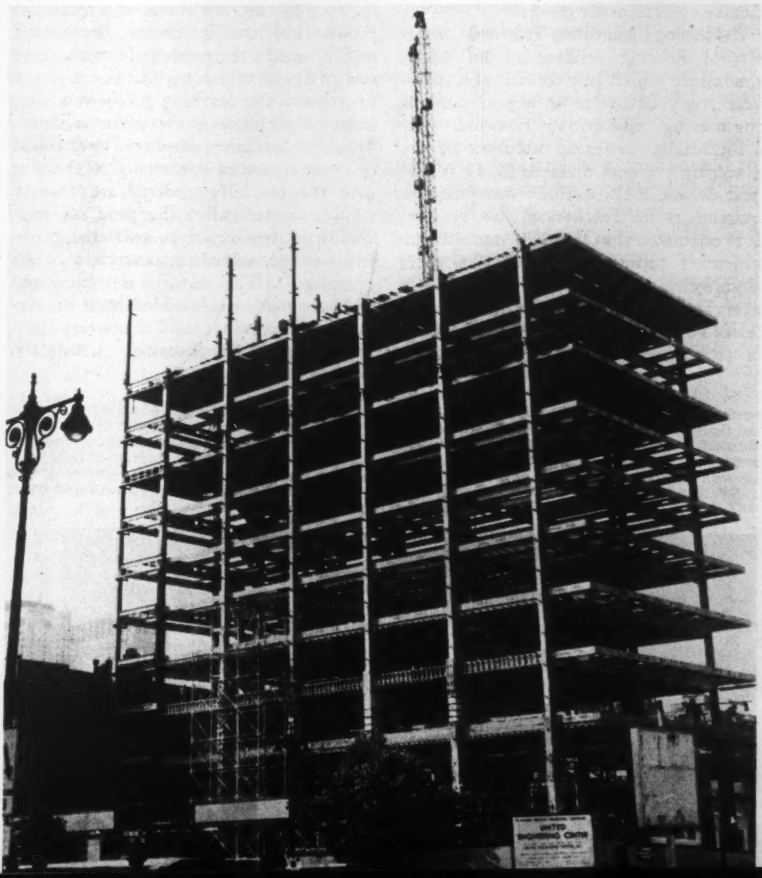
"The profession of law and government... is older than that of engineering and I am acutely aware of the fact that the stature and prestige of the professional engineer has become firmly entrenched during the lifetime of most of us. Patterned more or less upon the principles which for centuries have applied to law and to medicine, the practice of engineering is founded upon self-imposed standards, is monitored by Societies such as those which have combined to create this building as a reality, and is certified by legislative and educational requirements.

"The stature and prestige of professional engineering must be preserved and advanced in no lesser degree of perserverance than in law or in medicine. No longer is the engineer regarded as a man of war but, rather, he has become one of us in the older professions and among us a force for the good of his community and our society as a whole.

"It is my hope," Mayor Wagner concluded, "that engineering will continue to preserve New York City as the marvel of the New World and that in cementing this symbolic stone we will have strengthened not only the foundation of a highly significant professional building but our healthy and dynamic society in which we have implicit confidence to surmount trouble and survive threat, not only during our times but beyond the distant future."

Andrew Fletcher, President, United Engineering Trustees, Inc., presided; Willis F. Thompson, Mem. ASME, chairman, Real Estate Committee, and vice-president, United Engineering Trustees, Inc., described the cornerstone and its contents; and the Reverend Raymond H. Rosché, Pastor, The Presbyterian Church of the Covenant, New York, N. Y., gave the Benediction.

**New York City's Mayor Robert Wagner makes keynote address at cornerstone ceremonies**



**Progress on the United Engineering Center, 47th Street and United Nations Plaza, continues at rapid pace. Occupancy of the Center by ASME and 17 other engineering groups is planned for mid 1961.**

## Over $110,000 to Go

### Region II Also Over the Top

ASME's record to date in the Member Gifts Campaign does not compare favorably with those of other Founder Societies. The American Society of Civil Engineers, for example, with the same quota and fewer members, has received more contributions or pledges and has less than $30,000 to go to reach its goal, while ASME has approximately $110,000 to go. Only three of our members out of every ten have given to date!

As reported last month, Region II (Metropolitan New York area) closely followed Region V in going over the top. Some Sections also show excellent achievement and continue to demonstrate that the job can be done. It is hoped that all members of ASME will support the effort in putting ASME over the top at an early date.

# 3000 Attend 68th Annual ASEE Meeting at Purdue University

- Discuss engineering problems in this period of critical shortage of trained manpower;
- Seek better use of the nation's educational potential.

Purdue University served as the gracious host for the 68th annual meeting of the American Society for Engineering Education on June 20-24, 1960. A record attendance in excess of 3000 members and their families participated in the 145 events of the meeting, many of which were held in the spacious quarters of the Purdue Memorial Union and Memorial Center.

At the opening session held in the Edward C. Elliott Hall of Music, one of the world's largest theatres, located on the Purdue campus, a welcoming address was presented by Dr. G. A. Hawkins, Fellow ASME and Dean of Engineering at Purdue. Dean B. R. Teare, Jr., of Carnegie Institute of Technology, retiring president of ASEE, delivered his presidential address on the subject "Wanted: Leadership in Engineering Education." Dean Teare devoted much of his address to the need for additional graduate work, both to train faculty members needed by engineering colleges and to increase the quality of graduate work outside of the area of research. He stated: "Not all of engineering at the highest levels is research, and it may be that we should consider a professional degree which is no less demanding than our present doctorate, but differing from it in conception and purpose much as the MD differs from PhD degree."

**Honors and Awards.** Three of the four highest awards in engineering education were presented to ASME members. Dr. Theodore von Karman, Mem. ASME and chairman of the Advisory Group on Aeronautical Research and Development of NATO, was awarded the Lamme medal for distinguished contributions to engineering education and research. Dr. Maurice Zucrow, Fellow ASME and Atkins professor of engineering at Purdue University, received the Vincent Bendix award for outstanding research contributions. The George Westinghouse award for outstanding teaching ability in a young engineering faculty member was awarded to Dr. Robert B. Bird, professor of chemical engineering at the University of Wisconsin, and the Curtis W. McGraw award for research contributions by a young engineering teacher, to Dr. Ali B. Cambel, Mem. ASME and chairman of the mechanical engineering department of Northwestern University.

An honorary membership in the American Society for Engineering Education was presented to Dr. Henry T. Heald, Mem. ASME and president of The Ford Foundation.

The incoming president of ASEE is Dr. Eric A. Walker, president of The Pennsylvania State University.

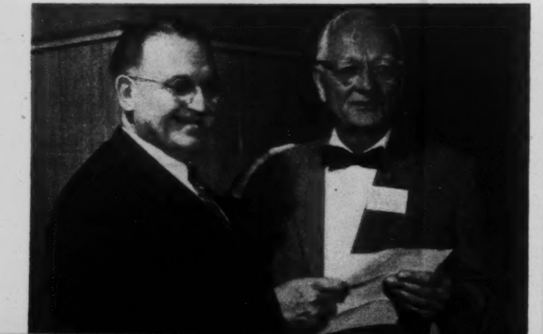
In an address entitled "Engineering Education in Our Age" Theodore von Karman emphasized that, after all, the engineer is a man who creates not only ideas and theories but also bridges, machines, and airplanes. He added that his purpose is creating hardware and that we should not underestimate his faculty and talent for design.

**Developing Engineering Teachers.** Prof. Harold Foecke, director of an ASEE committee which just concluded a three-year study of the most urgent need of engineering education, reported that substantially increased numbers of engineering teachers must be found in the next decade if the nation's mounting requirements for teachers are to be met. It is estimated that by 1967 American engineering colleges will need 7000 more engineering teachers whose salary should average $12,500 in 1967 dollars. Professor Foecke emphasized that the quality of technological education in the next ten years depends critically upon our success in bringing new talents to teaching and that to insure the needed quality, the teachers of today must become salesmen for teaching as a career. Also, more research and development on the process of engineering education are needed to make our present teachers increasingly effective.

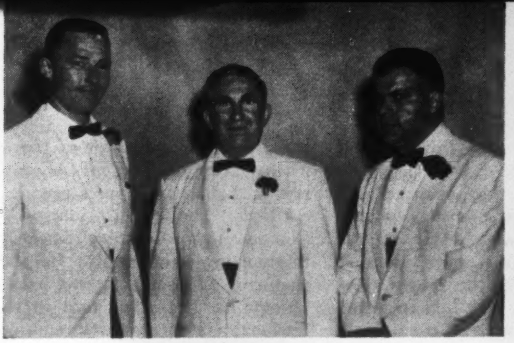
Along with the need for more engineering teachers, attention was focused on the better utilization of teachers through the application of learning—teaching machines. In a paper entitled "The Automization of Socrates," Prof. D. L. Cook of Purdue University stressed that teaching machines are a challenge for education since they reflect the changes in our modern society regarding the greater use of automation in daily living. He stated that what was needed was not so much research on the development of new mechanical learning—teaching devices—as additional research and exploration on the problems regarding types of material which can be presented to students by this means. The aim of these machines is to achieve some sort of automatic tutoring or self-instruction by replacing the personal presence of the instructor, designated by Socrates in the paper title, with some sort of device which permits the students to achieve the learning goals at a rate independent of large classroom sections. Teaching machines employ a mechanical or other means of presenting to the student the carefully ordered sequence of subject matter called the program consisting of questions to be answered, problems to be solved, or exercises to be completed. This material is re-presented and new material is added until the student achieves a set level of mastery.

**Mechanical Engineering Laboratory.**

James S. Thompson, **right,** of Princeton, N. J., was one of two men presented with honorary membership in the American Society for Engineering Education for "eminent service to mankind in engineering education." ASEE President B. R. Teare, Jr., tenders his congratulations at the 68th ASEE annual meeting held at Purdue University. Dr. H. T. Heald, Mem. ASME, president of The Ford Foundation, was granted an honorary membership in absentia.



Theodore von Karman, Mem. ASME, **right,** told ASEE at a general session that one of the major problems facing engineering students is the difficulty in teaching students to make the transition from theories to practical conclusions. He stated that only the solution of this problem can stop the trend among students away from engineering and toward science. Dr. C. L. Eckel, **left,** is ASEE vice-president and dean of engineering at the University of Colorado.



Highest awards in engineering education during the ASEE meeting went to Dr. Robert B. Bird, **left,** professor of chemical engineering, University of Wisconsin, recipient of $1000 George Westinghouse award for outstanding teaching ability in a young engineering faculty member; Dr. Maurice J. Zucrow, **center,** Fellow ASME, director of Purdue jet propulsion labs, the Vincent Bendix award for outstanding research; and Dr. Ali B. Cambel, Mem. ASME, **right,** chairman, Northwestern University mechanical engineering department, who won the $1000 Curtis W. McGraw award for research contributions by a young engineering teacher. The Lamme gold medal for distinguished contributions to engineering education and research went to Dr. Theodore von Karman, Mem. ASME, chairman of the Advisory Group on Aeronautical Research and Development for NATO. In photo **at right,** two of the leaders participating in the 68th ASEE annual meeting stop to chat. George A. Hawkins, Fellow ASME, **left,** is dean of engineering at Purdue, and Dr. Lillian M. Gilbreth, Hon. Mem. ASME, Montclair, N. J., is noted as the foremost woman engineer in the world.

Two papers were presented on the subject of the present and future place of the mechanical engineering laboratory on the college scene. In answer to the question, "Is It Time to Eliminate the Mechanical Engineering Laboratory?" Prof. K. R. Wadleigh of The Massachusetts Institute of Technology adopted as a ground rule that the role of analysis cannot be taught only in the classroom, the role of experiment in the laboratory, and the role of synthesis only in the design room, for all phases of engineering must be taught at every opportunity. He submitted that the objective of a laboratory is to teach an attitude which is basic to all professional engineers and scientists, involving reliance upon the scientific method, of which the cornerstone is experiment. In his conclusion, Professor Wadleigh stated that if one evaluates the present heat-power laboratory operations in terms of the suggested objectives, he is forced to the conclusion that such laboratories cannot hope to satisfy these objectives and that these have a detrimental effect on both staff and students because they convey a false impression of what is experiment and what is the place of experimental engineering. Instead of the traditional mechanical-engineering laboratory, experimental effort must be cast in its true role and closely allied with classroom work. To achieve this objective in the mechanical engineering field, a trend toward small, cheap, expendable apparatus is inevitable, and a major effort will be required to develop the required "bread boarding" techniques.

In answering the question, "Is It Time to Revolutionize the Mechanical Engineering Laboratory?" G. B. Carson, vice-president of Ohio State University, cited as an example the experience of the medical profession with laboratory training. In medical schools as much as 87 per cent of the student time may be expended in laboratory work, as contrasted to 13 per cent in didactic or formal teaching. Noting that it is easier to find the teacher of theory than the one interested in the art of engineering, Mr. Carson contended that it is possible to take all of the excitement and zest from the curriculum as far as the young engineering student is concerned. He expressed the hope that something might be developed which would replace the comprehensive senior projects formerly used by many mechanical-engineering departments. Instruction provided by mechanical-engineering laboratories may include confirmation of known physical laws, the opportunity to teach through the percept route which aids in student motivation, and the feel and acquaintanceship which the student gains with full-scale engineering devices.

**Power-Plant Teaching.** Prof. L. Blackshear of the University of Minnesota, expressing reluctance to speak concerning a course he had never taught, presented a paper on the subject, "Should There Be an Undergraduate Course in Power Plants?" In essence, his answer was that it would be a good idea if the college had a faculty member who wanted to teach a course in power plants. Such a course, he conceived, should be concerned with the elements of power plants and their interaction. For present and future power requirements, the basic elements are sociology and anthropology. Basic elements for energy sources include economics, geology, and meteorology. Thermodynamics is the basic element for heat cycles, while in power-plant component design the basic elements include nonequilibrium thermodynamics, fluid mechanics, heat transfer, combustion processes, and nuclear processes. Another requirement is that the professor be "sophisticated" in the power-plant field in order to give valid problems which can be used to tie together other parts into a meaningful relationship and interplay. If time did not permit a separate course in power plants, the elements could be worked into other more basic courses which should be coordinated so that when they are completed the students would, in effect, have had a course in power plants.

An industry representative who was in attendance raised a question along these lines: If colleges are training men for industry, should not the needs of industry rather than the interest of faculty members determine whether or not a power-plant course should be included in the curriculum? Other persons discussing this paper pointed out the value of a power-plant course as a synthesis of many engineering subjects, particularly if it is treated under the topic of energy conversion combining internal-combustion engines, gas turbines, and steam power.

**Teaching of Kinematics.** E. S. Ferguson, curator of the division of mechanical and civil engineering of the Smithsonian Institute, presented a historical survey entitled "Kinematics of Mechanisms From the Time of Watts." Noting that there has been no history of kinematics written to date, Mr. Ferguson pointed out that James Watt, together with Matthew Boulton, brought about a revolution in large mechanisms and that historically kinematic synthesis preceded kinematic analysis. The first teaching of kinematics began in the École Polytechnique in France in the early eighteen hundreds. Pioneers in this school included G. Monge and Hachette who developed a major chart of mechanisms that has been reproduced many times in the intervening years. The modern approach to kinematics can be traced to Prof. Robert H. Smith of Birmingham College who expressed many of the ideas of modern kinematic analysis as early as 1885. Mr. Ferguson especially urged future textbook writers to take the time to read of some of the earlier developments in kinematics and to interpret their teaching value.

**Materials for Undergraduate Engineers.**

Prof. B. A. Reese of Purdue University, speaking on the subject of "Education in Materials for Mechanical Engineers," stated that the engineering graduate must be able to specify materials for both present and future designs. The mechanical engineer deals with an extensive range of materials ranging from plasmas to liquids, including metals and plastics. Professor Reese felt that the design function must be kept continually in mind and that, while the course in materials should have a scientific basis, it should be directed toward design. The mechanical-engineering student must become aware that the study of materials is a never-ending task throughout his engineering career. He should become acquainted with the best reference works of materials and the important laboratories in the field.

**Mathematics and Computers.** In paper entitled "The Reconstruction of Mathematical Education" by Prof. W. W. Sawyer of Wesleyan University, it was pointed out that a college mathematics professor faces the difficult situation that his students have had 12 years of conditioning to rote learning. If college teaching is to become more effective, this means that changes will have to occur at earlier levels, and the critical point lies somewhere in the elementary or junior high school. Professor Sawyer added this observation: "Children are born wanting to think and discover for themselves; rote teaching systematically destroys their powers of thoughts; the older the students are, the less curiosity and intelligent interest you can expect." With respect to engineering, the problem of analyzing an actual situation in mathematical terms is probably as difficult as anything encountered. Yet, according to Professor Sawyer, little or no practice is given to the engineering student in this all-important skill of formulating problems.

Professor Sawyer also expressed the idea that the elementary educational system is overorganized to the point that it is extremely difficult for the enthusiastic student to advance at his own rate without the assistance of a teacher.

W. F. Miller, director of the applied mathematics division of Argonne National Laboratory, presented a paper entitled "The Application of Digital Computers to Complex Scientific and Engineering Problems." He indicated that this type of computer will likely become an important tool in the professional life of research and development scientists and that they therefore should have some introduction to it in their undergraduate days. In a paper entitled "The Fundamental Assets of Computers" Prof. Sidney Shore of The University of Pennsylvania stated that the greatest asset of the computer in engineering education is the related "computer methodology." To employ the computer intelligently, the user must progress through a logical sequence of events before he ever approaches the machine, and it is this computer methodology which requires rigorous and demanding thought processes. The very fact that the enthusiasm of the student is aroused with the possibility of using a computer is of assistance to getting him to think in more meaningful ways.

## LITERATURE

### New Books

**Mechanical Presses.** "Mechanical Press Handbook," published by *Metalworking* magazine, covers the range of mechanical press design and use from basic components to complete operating units including transfer and high-productivity presses. Besides information on types of equipment, the authors discuss economics, giving a clear picture of the role these high-precision machines can play in modern industry. This 256-page book is available from *Metalworking* Magazine, 221 Columbus Ave., Boston, Mass., at $5 a copy.

**Air Conditioning.** "System Design," the third volume of Carrier Corporation's new Engineers Manual, has been released. This 350-page, illustrated reference on air conditioning and refrigeration is designed to bridge the gap between air-conditioning texts and manufacturers' catalogs. It contains parts on load estimating, air distribution, and piping design. Available from Carrier Corporation, Syracuse 1, N. Y., and other Carrier field offices.

**Information Processing.** Proceedings of a 1959 international conference on information processing organized by UNESCO have been published in a 600-page volume entitled, "Information Processing." It includes information on methods of digital computing, common symbolic language for computers, automatic translation of languages, pattern recognition, and machine learning, and contains the full text and summary of each of the 61 papers discussed and summaries of the 65 lectures given at the conference attended by 2000 experts from 39 countries. Available at $25 a copy from International Publications Service, 507 Fifth Ave., New York 17, N. Y.

### Inter-American Communication

A PAPER on "Inter-American Scholarly Communication in the Humanities and Social Sciences," prepared by Frederick Burkhardt, president of the American Council of Learned Societies for the Conference on Higher Education in the American Republics, held in Santiago, Chile, Feb. 21–26, 1960, is available. This study was made at the request of the Council on Higher Education in the American Republics resulting from discussions with leading North American and Latin American educators who indicated a need to improve scholarly communication. Copies are available from the Institute of International Education, 1 East 67th Street, New York 21, N. Y.

### Engineering Research

"ENGINEERING College Research Review, 1959" has been published by the Engineering College Research Council of ASEE. It lists institutes where research is going on, research policies, personnel, expenditures, and projects now active. Available from Office of the Secretary, The American Society for Engineering Education, University of Illinois, Urbana, Ill., at $2 a copy.

### Instrumentation

A NEW abstracting service, Instrumentation Abstracts, has been inaugurated by Charles Doak Lowry, Jr., and Seaton T. Preston, Jr. The objective of Instrumentation Abstracts is to cover all significant articles on instrumentation which are of interest to technical personnel in this field. The emphasis is on instrumentation in the process industries, including chemical, petrochemical, petroleum, food, glass, and steel. The service will aim to present all published information on instrumentation in a logically classified manner so it can be assimilated by instrument engineers and technologists. The cost of subscription to the service is $50 per month or $600 per year, for one set of abstracts. Additional sets sent to the same address are $20 per month each. Available from: Instrumentation Abstracts, 80 East Jackson Boulevard, Chicago 4, Ill.

### New Publication

"ENGINEERING OUTLOOK" is a new publication of the University of Illinois

Engineering College. It is designed to keep the public aware of current happenings in the College's program of research, education, and public service. It will be published when there is enough news of interest to make up an issue, approximately every four to six weeks. Sent without charge, on request, from the Engineering Publications Office, 114 Civil Engineering Hall, University of Illinois, Urbana, Ill.

**Standards**

- "American Standard Letter Symbols for Rocket Propulsion," ASA Y10.14-1959, $2.
- "Time-Study Charts," ASA Y15.2-1960, $3.50.
- "Research Highlights of the National Bureau of Standards," the 169-page annual report for 1959, brings together important developments in the science of measurement arising in the Bureau's 1959 research program. Order National Bureau of Standards Miscellaneous Publication 229 at 55 cents a copy from: Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
- "Square and Hexagon Bolts and Nuts," ASA B18.2-1960, sponsored by SAE and ASME, has been published. Available at $2 a copy with a 20 per cent discount to ASME members when purchased from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

## PEOPLE

**Honors and Awards.** Guy W. Morrison, who spent 47 years in engineering sales and advertising with Ingersoll-Rand, was named winner of the Marston Medal at Iowa State University. The medal is awarded annually to an alumnus in recognition of outstanding achievement in the field of engineering.

To honor outstanding achievement in the field of agriculture, the American Society of Agricultural Engineers awarded the John Deere Gold Medal to William Virgil Hukill, Ames, Iowa; and Cyrus Hall McCormick Gold Medals to Fred A. Brooks, Mem. ASME, Davis, Calif., and to Walter H. Silver, Brownsville, Texas.

The Trinks Award—the highest honor in the industrial heating equipment industry—was presented to two of the nation's foremost authorities on metallurgical furnaces at a banquet held at the Duquesne Club, Pittsburgh, Pa. in June. The recipients of the award, William B. Wallis, and Ernest W. Weaver, Mem. ASME, are pioneers in the development of electric arc melting furnaces and of heat-treating furnaces, respectively.

Theodore von Karman, Mem. ASME, chairman of the Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization, was conferred with an honorary Doctor of Science degree by New York University, Bronx, N. Y.

Loren K. Olson has been nominated by President Eisenhower to be a member of the Atomic Energy Commission. He has been General Counsel of the AEC since 1958, advising the Commission in all of its activities.

**New Officers.** Stefan L. Grapnel, Mem. ASME, of West Thompson, Conn., was named president of the Connecticut Society of Professional Engineers at the state meeting held in June.

**Campus Data.** William A. Patterson has been appointed Provost, the chief academic officer, of Fenn College, Cleveland, Ohio.

Barnett F. Dodge, chairman of the Department of Chemical Engineering, Yale University, has been named Dean of the Yale University School of Engineering. The one-year appointment was effective July 1, 1960. He succeeded Dana Young, Mem. ASME, who resigned to give full time to teaching and research.

## MEETINGS OF OTHER SOCIETIES

### •IN THE UNITED STATES

**Aug. 17–19**

American Society of Civil Engineers, Hydraulics Conference, University of Washington, Seattle, Wash.

**Aug. 18–20**

National Council of State Boards of Engineering Examiners, 39th annual meeting, Hotel Multnomah, Portland, Ore.

**Aug. 22–24**

Cryogenic Engineerng Conference, sponsored by NBS and Cryogenic Engineering Conference Committee, University of Colorado, Boulder, Colo.

**Aug. 22–26**

Western Resources Conference, University of Colorado, Colorado State University, and Colorado School of Mines are sponsors, University of Colorado, Boulder, Colo.

**Sept. 6–16**

Production Engineering Show, Navy Pier, Chicago, Ill.

**Sept. 6–16**

Machine Tool Show, first since 1955, International Amphitheater, Chicago, Ill.

**Sept. 11–16**

American Chemical Society, national meeting, New York, N. Y.

### •IN EUROPE

**Aug. 22–27**

Koninklijk Instituut van Ingenieurs, seventh conference on coastal engineering, The Hague, Holland.

**Aug. 28–31**

Verein Deutscher Ingenieure-Hauptgruppe History of Technology in co-operation with the Deutsche Gesellschaft für Geschichte der Medizin, Naturwissenschaft und Technik (Bonn), Lüneburg, Germany.

**Aug. 29–Sept. 2**

Société Royale Belge des Ingenieurs et des Industriels, host to EUSEC Conference, Brussels, Belgium.

**Aug. 29–Sept. 3**

Czechoslovak Academy of Sciences-International Union of Pure and Applied Physics, fifth international conference on semiconductor physics, Prague, Czechoslovakia.

**Aug. 31–Sept. 7**

International congress of applied mechanics, Stresa, Italy.

**Sept. 5–9**

Czechoslovak Chemical Society, conference on chemical engineering science, Prague, Czechoslovakia.

**Sept. 12–17**

International Council of the Aeronautical Sciences, second congress, Zurich, Switzerland.

**Sept. 16–20**

Société Hydrotechnique de France, symposium on "Hydraulic Turbine Research," Nice, France.

**Sept. 21–23**

VDI, Commission for Clean Air, Questions on Clean Air, Wiesbaden, West Germany.

**Oct. 2–5**

VDI, Society for Chemical Engineering in the Association of German Engineers, Mannheim, Germany.

**Mid-October**

VDI-Fachgruppe Vibration Engineering, vibration conference, Essen, Germany.

**Oct. 17–19**

K.I.v.I., International Congress on Plastics, Amsterdam, Holland.

**Oct. 20–21**

VDI-AWF-Fachgruppe Gear Engineering, international conference on gearing, Essen, Germany.

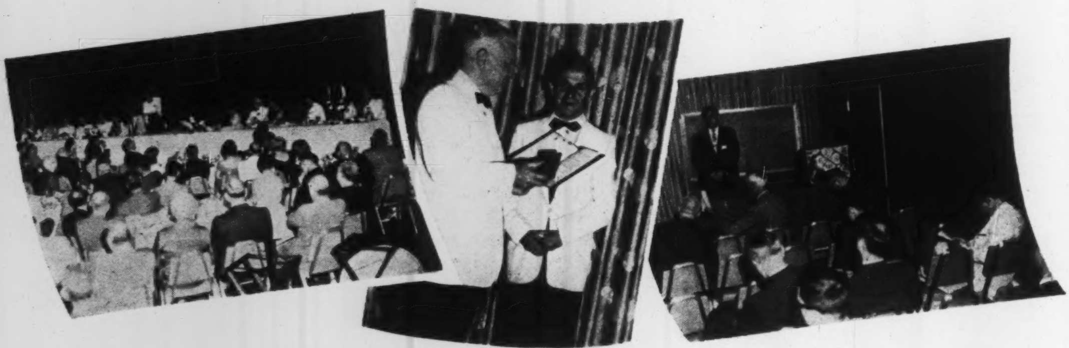
(*For ASME Coming Events see page 128.*)

Notes on
Society Activities
and Events

E. S. NEWMAN
News Editor

# THE ASME NEWS

## 1960 ASME Summer Annual Meeting



These things happened at Dallas. **Left to right:** "Lum" turns deadly serious at the banquet. . . . Samuel Glasstone receives the Worcester Reed Warner Medal for his "Sourcebook of Atomic Energy." . . . The chips are down in the Old Guard Competition. A. P. Meyer of Stevens Institute presents his paper. . . . Little sure-shot. Our girl-of-the-golden-West goes into her act. . . . Check for

The 1960 Semi-Annual Meeting (henceforth to be known as the "Summer Annual Meeting") of The American Society of Mechanical Engineers was held in Dallas, Texas, June 5–9, 1960, at the Statler Hilton Hotel. With the general meeting there also took place the Aviation Conference presented annually by the Society's Aviation Division. These combined meetings were held in co-operation with the North Texas Section of ASME as well as the Human Factors Society. Altogether, more than 700 engineers assembled in the Texas metropolis.

The meeting proved a triumph in at least one field of mechanical engineering—air conditioning. This started at the airport, continued with the airport limousines, and rarely stopped—even the private cars are air conditioned in Dallas. The ambient temperature touched 97 F, but one learned of this by hearsay. The Statler Hilton had a system driven by two 785-hp steam turbines operating two 700-ton air-conditioning units, with the cooling capacity of a small iceberg.

Dallas, an aviation center, presented a picture of trim prosperity. Architects and mechanical engineers have had a free hand. If it's new, Dallas has it, from a warehouse that looks like an overgrown ranch-type residence, to tall parking garages that lift your car many stories above the street and park it like palletized warehousing—no driver at the wheel. Everything looked so new one was surprised to find people already working in the buildings.

The summer Meeting has traditionally been a business meeting for the Society's Council and committees. The Council thrashed out matters ranging from financial details of the Society's operation to questions of basic policy such as united action with the other leading engineering societies. At the banquet, Secretary O. B. Schier, II, following long-established custom, opened the envelope given him by the Nominating Committee and read the names of the nominees for new Directors, Vice-Presidents, and the President for the following year. Nominated for President for 1961 was William H. Byrne, president of Byrne Associates, Inc., of New York, N. Y.

### The President's Luncheon

The President's Luncheon is a traditional event, held always on the first day of the summer Meeting. Harold Grasse, Vice-President of ASME's Region VII (southwest and Rocky Mountain states), served as toastmaster. Lester T. Potter, president of the Dallas Chamber of Commerce—himself an engineer—welcomed the gathering to Dallas with a special greeting for his "competitor," our President. Mr. Potter is president of the Lone Star Gas Company, while Mr. Cisler is president of Detroit Edison. Said Mr. Potter: "The kilowatt boys keep us on our toes." (He spoke of Mr. Cisler as an "industrial statesman.")

Before his speech, Mr. Cisler presented to Past-President William F. Ryan a certificate awarded by the Council for his service as Chairman of the Member Gifts Committee for the United Engineering Center now being erected at United Nations Plaza in New York City. He also presented to Dr. Mervin D. Hogan of General Electric a certificate of his advancement to the grade of Fellow of the ASME.

This occasion marked the halfway mark in Mr. Cisler's year as President. He congratulated the Aviation Division on its fortieth anniversary. He could do this with more than ordinary feeling and insight, because his recent mission as consultant to the Department of Defense, concerned with missile-testing ranges and satellite-tracking facilities, brought him up to date on the accomplishments of the men of the Aviation Division.

**$1000.** J. P. Mooney presents the Petroleum Division's check to President Cisler for the building fund of the United Engineering Center. . . . "Will the nominee please stand?" W. H. Byrne learns that he has been nominated for President of ASME in 1961. . . "A most insecure, dependent population." Prof. W. W. Finlay of Antioch talks on America's "total objective."

The Presidential address was entitled "ASME Looks to the Future," and it appears in condensed form in this issue of Mechanical Engineering (pages 36–38). Mr. Cisler gave the group a frank appraisal of the problems facing the Society, and of the policies and new directions under consideration by ASME's leadership.

At the author's breakfast on Tuesday morning, June 7, Mr. Cisler spoke on the role of the engineer in international affairs. He expressed his belief that engineers in all countries—the men who build—can establish a meeting of the minds. He mentioned President Sukarno of Indonesia, who is a civil engineer. He spoke of Deputy Premier Koslow of the Soviet Union who is a mechanical engineer, a metallurgist. He reported a conversation that took place in Russia, when he and Koslow had talked of an international power plant to be built jointly by both countries in some neutral nation, perhaps India.

At the breakfast, Mr. Cisler "administered the oath of office" to the technical session Chairmen, as he did on succeeding days of the Meeting.

### The Management Luncheon

At the Management Luncheon—Hugh A. Bogle of du Pont, Chairman of the Management Division, presiding—the main speaker was William W. Finlay, professor of business administration, Antioch College, Yellow Springs, Ohio. Professor Finlay rocked his audience with this statement:

"We've created the most insecure, most dependent population in the world."

This, he explained, is the result of mass production.

"We took the skill out of the production of goods," he said. "We devised machines, and put the decisions in the machines. We took from the people the need to make decisions. Why should people reach out and stretch their minds when they can make a good living without thinking?"

To what extent is management responsible for the aimlessness of American life? Professor Finlay considers management heavily responsible, and he feels it is management's duty to make a complete examination of the social process—not an indictment of the past, but a projection into the future. Management must discover the goal that people now lack.

"In the war," he said, "we had a simple, understandable objective. We amazed the whole world—and ourselves. We had a goal. Now we don't, and we must find one."

He made the point that a manager's decisions make ethical and moral judgments. A decision made in one company can echo throughout a community and even throughout the nation. A manager must have a sense of responsibility that goes beyond his own company.

Is there a natural corrective process for narrow, shortsighted management? There probably is, but we'd better not wait for it. It's later than we think. Professor Finlay said, "Management can and must develop a common social objective. We need a total objective. We have power, but we have no concept of responsibility—that means a goal.

"It's going to be hard," he said, "but it's imperative."

### The Petroleum Luncheon

At the Petroleum Luncheon on the third day of the Meeting, J. P. Mooney of Humble Oil & Refining Company, Chairman of ASME's Petroleum Division, served as toastmaster. E. J. Wacker, Jr., of Magnolia Pipe Line Company introduced the main speaker, Martin Goland of Southwest Research Institute. Mr. Goland made an address entitled "Beyond the Captured Territory," in which he discussed those philosophic questions which engineers ought to recognize as important but which are neglected because they are not yet susceptible to the scientific method.

Once the science which now serves us so powerfully was only a gleam in the eye of the philosopher. When it yielded to experimental and mathematical analysis—became captured territory—

philosophers moved on to new, unexplored regions of thought. Today, for example, the relationship between engineering and over-all human need is not seen clearly and is not subject to calculation. It is in the realm of philosophy. But engineers should not regard this fact as an excuse to ignore the problem.

Mr. Goland's speech will appear in condensed form in a later issue of MECHANICAL ENGINEERING.

### Banquet Night

Banquet night of the summer Meeting marks the height of the Society's mid-year social season. C. H. Shumaker, chairman, Department of Industrial Engineering, Southern Methodist University, Dallas, presided. The invocation was given by C. J. Eckhardt, Fellow ASME.

The banquet is a time for the awarding of some of the Society's most coveted honors. This year, the Worcester Reed Warner Medal went to Samuel Glasstone, consultant to the U. S. Atomic Energy Commission at Los Alamos, N. Mex., for his "Sourcebook on Atomic Energy," which is the first definitive reference text on atomic energy.

The Worcester Reed Warner Medal, established in 1930 in honor of a Past-President of ASME, is a gold medal bestowed for an outstanding contribution to permanent engineering literature. Mr. Glasstone, who wrote his book at the suggestion of the Atomic Energy Commission, spoke to the banquet of the commingling of scientific and engineering disciplines brought about by modern developments.

"A chemist writes a book on physics," he said, "and gets honored by an engineering society." Besides the "Sourcebook," Mr. Glasstone is the author of more than 20 other books on nuclear energy, electrochemistry, thermodynamics, and physical chemistry.

A feature of every mid-year banquet is the announcement of the winner of the Old Guard Contest—curiously named, since it is a competition open only to our youngest members, the student engineers, who compete in presenting technical papers. The judging takes into account not only the value of the paper itself, but the skill and effectiveness with which it is presented. The final competition takes place at the Summer Annual Meeting, and the winner is invited to present his paper again at the Winter Annual Meeting in New York. Winner, this year, was Joseph W. Lindsey of the University of Utah, Salt Lake City, whose paper was entitled "A Cold-Flow Study of Nozzle Feeding in the Four-Nozzle Rocket Case."

A closely guarded secret, prior to the banquet, was the awarding of the grade of Fellow of ASME to O. B. Schier, II, and C. H. Shumaker. Neither man knew of his own appointment (in the case of Secretary Schier, this took some doing—his certificate was signed by Secretary-Emeritus C. E. Davies), and each man was assigned to present the certificate to the other. Both were at the head table, of course; Mr. Shumaker was presiding. Perhaps only the Staff fully appreciated the drama of the presentations.

J. P. Mooney, Chairman of the Petroleum Division, presented to Mr. Cisler a check for $1000 on behalf of his Division in support of the United Engineering Center. This is not the first time that a Division has made a gift for the new building. Early this year, Oil and Gas Power also made a Division contribution.

### A Pro at the Rostrum

Chester H. Lauck, main speaker of the evening, is more than an old hand at public speaking—he's the man who was "Lum," of Lum and Abner fame in radio and the movies. He is also executive assistant, Continental Oil Company. If that seems bewildering—that a nationally known comedian should also be a top-flight business executive—well, that's how it is. Mr. Lauck has lost none of his craft in mesmerizing an audience and rolling them in the aisle.

But when he turns serious, he turns very serious indeed. His speech, "The Eleventh Hour," was just as grim as it sounds. His theme: We are $295 billion in debt, sinking further as we lean more and more heavily on government aid; we are following in the path of the once-great nations that grew soft and then sickened and fell; we need to get hold of ourselves.

"Some economists say we are beyond the point of no return," he said. "This is hard to believe. We must realize, however, that this is the eleventh hour. We must realize the direction toward which we are drifting and do something about it now."

For one thing, we must concern ourselves with government, not let the politicians run us. Leave it to the politicians, and you get more debt, socialistic welfare programs, and the increasing threat to our free and competitive enterprise system.

"We can and must select men for office who will think of the next generation rather than the next election," he said. "Men who will dedicate themselves to the preservation of our Constitution and our individual freedom . . . freedom of every man to become whatever his vision, his manhood, and his faith can combine to make him."

### Meanwhile, Back at the Ranch . . .

On the second evening, some 200 of the assembled engineers and their ladies journeyed 30 miles outside Dallas by bus for a ranch party—the Austin Patio Ranch, Grapevine, Texas. The local committee had taken the precaution of providing rain, earlier in the day, and the evening was cool, the ground no longer dusty, the ranch reminiscent of a New England farm. After a Texas-style barbecue, a girl in western costume entertained with an Annie Oakley act, using a .22 pistol, and later a bull whip. Marvelously accurate with both weapons. An electronic device might have aimed with even greater accuracy, but the young lady was better looking (matter of opinion, of course).

As a finale, there was a rodeo—calf roping, bulldogging of steers, barrel racing, bronco busting. Exciting to watch. It became increasingly clear why the automobile has replaced the horse. The little, hard-sprung sports car is probably a device for expiating secret guilt for having abandoned the hardships of the saddle.

### Women's Program

The women who accompanied their husbands to Dallas got around in air-conditioned cars. They had the "Cinerama Tour" of Dallas ("Big D"), and they went on the ranch party and attended the banquet. They had a luncheon at Neiman Marcus and watched modeling of styles in that famous Texas store. They heard a lecture on precious stones by a representative of Everts Jewelers, during which jewelry was passed around ("examples, not samples"), and they had a luncheon at the Dallas Athletic Club followed by a book review by Gay Katherine Marshall. Altogether, 35 women were on hand to enjoy these events.

### Field Trips

The men also got around. Texas Instruments, Inc., invited the conferees for a tour of their Semiconductor-Components Plant in suburban Dallas, the largest producer of semiconductor components in the world. Strict security, of course: Visitors were "registered in." Work in the plant is done under microscopes—thousands of microscopes—women being best at such tasks. The whole plant is dustproof—workers enter through air locks to eliminate dust.

The plant must design and produce its own production equipment.

Braniff International Airways held open house on the last day of the meeting, a behind-the-scenes tour of the Braniff Operation and Maintenance Base. Like everything else, it is new. Visitors saw everything, from the overhaul hangar and shops, to the flight control, meteorology, communications, and reservations. Their 10-ton Clayton Dynamometer engine-test cell is the first commercial installation of its kind in the Southwest.

### A Note on the Students

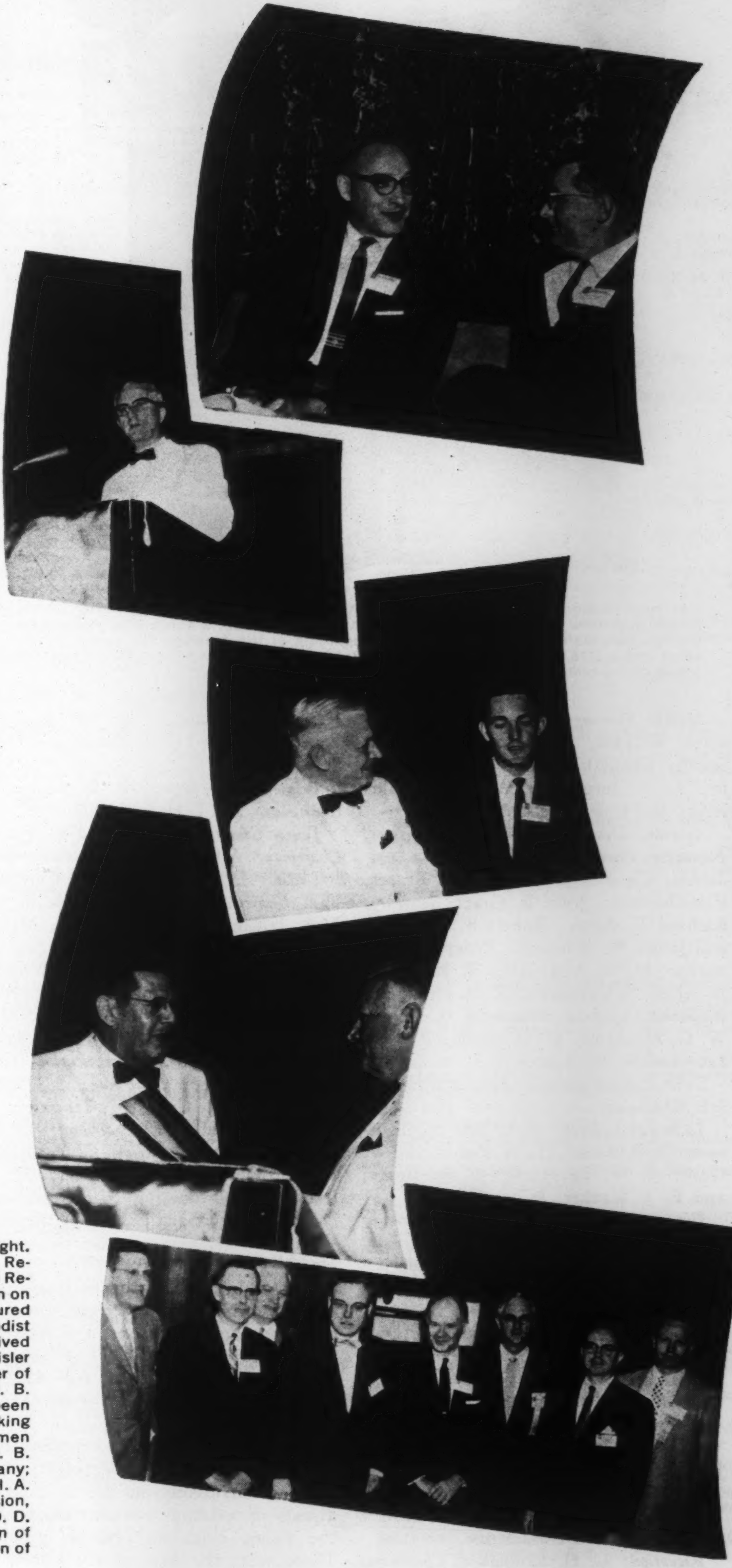
On the day of the student competition (the Old Guard Prize), President Cisler made a special address to the students at the author's breakfast. His subject: "Communication," a subject that is special to him because he has worked at communication all over the world. He pointed out that the contest bridges the gap between the student in his college career and the member engineer.

Every engineer who attends a Summer Annual Meeting would do well to sit in at a session of the student competition. Here are technical papers being delivered with platform skills that few senior engineers know about. Here is communication as it should be done.

Make a note: Next year's Summer Annual Meeting will be held June 11–15, 1961, at the Statler Hilton Hotel in Los Angeles, Calif.

### Committees in Charge

It takes a considerable company of dedicated people to manage a gathering of this size and have the scheduled events come off smoothly. The technical program is produced by the Professional Divisions and committees. But the luncheons, banquets, and other features which lend grace and solidarity to a meeting are in the hands of the Host Section—in this case, the North Texas Section. The following are the people whose efforts and leadership made this meeting a success:



More people and events in the Summer-Annual spotlight. **Top to bottom:** Martin Goland, **left,** of Southwest Research Institute with J. P. Mooney of Humble Oil and Refining. Mr. Goland spoke at the Petroleum Luncheon on problems the engineers must face "beyond the captured territory." . . . C. H. Shumaker of Southern Methodist University m-c's the banquet. Mr. Shumaker received his certificate as a Fellow of ASME. . . . President Cisler meets J. W. Lindsey, University of Utah, 1960 winner of the Old Guard Prize for Student Members. . . . O. B. Schier, II, Secretary of ASME, learns that he has been made a Fellow of the Society, President Cisler making the presentation. . . . Management Luncheon. The men of the head table were, **left to right,** Secretary O. B. Schier, II; P. R. Fortune of New York Air Brake Company; President Cisler; W. W. Finlay of Antioch, speaker; H. A. Bogle of du Pont, chairman of the Management Division, who presided at the Luncheon; C. H. Shumaker; D. D. Acker of North American Aviation; and J. P. Wilson of A. M. Lockett and Company, Ltd., of Dallas, chairman of ASME's North Texas Section.

LET'S FINISH THE RACE

Has your Section met its quota of contributions for the United Engineering Center? If not, you were represented by a turtle in the glass case, a turtle with your Section number painted on its shell. As of the beginning of the Meeting, the campaign was short some $116,000, with less than half of ASME's members heard from. You'll be proud of the building: Take part in its construction.

*ASME Meetings Committee:* W. Burdette Wilkins, *Chairman;* Lester C. Smith; Kenneth L. Selby; T. S. Fetter, Jr.; C. A. Jurgensen; Albert S. Goldstein; and E. F. Hoelscher.

*Aviation Division Conference Committees, Executive Committee:* Herbert W. Anderson, *Chairman;* Wilbur W. Reaser, *Vice-Chairman;* John B. Graef, *Secretary;* Richard P. Arms; Robert B. Dillaway, and James W. Wheeler. Program Committee: H. W. Anderson; W. H. Arata, Jr.; J. de S. Coutinho; R. B. Dillaway; B. Fishman; J. B. Graef; V. J. Kropf; W. G. Matheny; H. O. Olson; A. Raspet; and W. W. Reaser.

*General Arrangements:* Arnold R. Mozisek, *Chairman.*

*Technical Liaison:* F. C. Justice, *Chairman;* T. S. Bacon; L. A. Byron; C. W. Geve; J. W. Lacy; W. G. Matheny; and E. J. Wacker, Jr.

*Finance:* Clifford A. Cowles, *Chairman;* Dale E. Cunningham, *Vice-Chairman;* William B. Gregory; B. C. Heald, Jr.; and Pat S. King.

*Registration and Information:* Dale Stephenson, *Chairman;* L. W. Cumber; Dale E. Cunningham; R. A. Gates; W. C. Millis; and W. R. Weaver.

*Hotel:* Irving H. Comroe, *Chairman.*

*Plant Trips:* R. W. Cox, *Chairman;* W. H. McAlpin; G. W. Beesley; and J. R. Padgitt.

*Entertainment:* R. W. Smith, *Chairman;* T. L. Adamson; Sam Seabury; Roger Davidson; and Gerald Stone.

*Reception:* C. H. Shumaker, *Chairman;* Irving H. Comroe; L. W. Cumber; Ray M. Matson; C. A. Besio; and John Stevenson.

*Printing and Signs:* C. D. Laughlin, *Chairman;* and J. H. Swenson.

*Junior Committee:* Raymond E. Vache, *Chairman;* Albert J. Lee, *Vice-Chairman.*

*Ladies' Activities:* Mrs. Dale Cunningham, *Chairwoman;* Mrs. B. C. Heald, Jr.; Mrs. James Lacy; Mrs. Craig Millis; Mrs. Arnold Mozisek; and Mrs. Clifford Shumaker. Hostesses: Mrs. William Graff; Mrs. William Gregory; Mrs. John Stevenson; Mrs. John Wilson; Mrs. Charles Lofland; and Mrs. Felix Justic.

*North Texas Section Executive Committe:* J. P. Wilson, *Chairman;* P. S. King, *Secretary;* W. J. Graff, Jr., *Treasurer;* D. E. Cunningham, *Vice-Chairman;* L. W. Cumber; R. A. Gates; B. C. Heald, Jr.; W. C. Millis; D. C. Pfeiffer; M. J. Rudick; G. Stone; J. S. Stringfellow; H. B. Umberger; and J. Allen Whitesides.

## Technical Program

Although eight of the Society's professional divisions were represented in the 45 technical sessions, the Aviation Conference accounted for 24 sessions. This is a notable year for ASME's Aviation Division, its fortieth anniversary.

Founded Sept. 27, 1920, our Aviation Division was the first organization interested exclusively in the engineering aspects of aviation (as contrasted with the flying clubs and pilots' groups). Those were the days of the Curtis JN (Jennie) and the Liberty-engine DeHaviland 4-B. Edward P. Warner had just inaugurated M.I.T.'s course in aeronautical engineering. Ahead of the industry lay the developments in aeronautical, mechanical, and electronic engineering that were to give us air supremacy in two wars and bring about today's jet airliner and vehicles in space.

Curiously, one of the most stubborn aviation problems is an old one, metal fatigue. They solve it for airframes using thin aluminum-compound sheets: And then come the exotic metals, new compounds of aluminum, and thick-plate design, all producing new and unexpected aspects of metal fatigue. Aviation's Session 19 went into the search for a new approach to airframe structural design.

The Aviation Division is also keenly interested in new developments in short-haul vehicles, starting, of course, with aircraft that can take off and land in a small space—the VTOL's and STOL's. But they also heard papers on revolutionary ground transportation, notably the sliding vehicles that ride on a thin film of air. Aviation Sessions 4 and 9 discussed both the vehicles and the economics of short-range rapid transit.

The Professional Practice Committee held a panel session which thrashed out the conflict of interest that arises between manufacturers and consulting engineers in the installation of machinery. Should the manufacturer provide installation service "free," or should this be the recognized field of the consultant? Somebody pays, of course; ultimately the customer. But who is best qualified? How far do manufacturers go? How far should they go?

This can become a bitter argument when one manufacturer's drawings and specifications are furnished to a consultant, and then the manufacturer finds himself bidding against others for his own designs. On the other hand, equipment can vary widely, and one must expect that a manufacturer will tend to specify his own products. It's a problem that can only be clarified, not solved.

Other divisions which contributed papers to the Meeting were:

Heat Transfer, Instruments and Regulators, Machine Design, Management, Materials Handling, Petroleum, Process Industries, Nuclear Engineering, and the National Junior Committee. The following is a list of the available papers. Digest of all papers which are not scheduled for publication in MECHANICAL ENGINEERING will appear in the "ASME Technical Digest" in this or a forthcoming issue of MECHANICAL ENGINEERING.

## Availability List—Summer Annual Meeting

The papers in this list are available in separate copy form until April 1, 1961. Please order only by paper number; otherwise the order will be returned. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment also may be made by free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

### Heat Transfer

**60—SA-4** Some Temperature and Pressure Measurements in Confined Vortex Fields, by J. M. Savino and R. G. Ragsdale

**60—SA-7** The Influence of By-Pass Channels on the Laminar Flow Heat-Transfer and Fluid-Friction Characteristics of Shell and Tube Heat Exchangers, by F. L. Test

**60—SA-8** Experimental Determination of Limit of Supersaturation of Nitrogen Vapor Expanding in a Nozzle, by G. L. Goglia and G. J. Van Wylen

**60—SA-9** The Heat-Balance Integral—Further Considerations and Refinements, by T. R. Goodman

**60—SA-14** Transient Heating of Two-Element Slabs Exposed to a Plane Heat Source, by Henry Halle and D. E. Taylor

**60—SA-15** Temperature Distribution in an Internally Cooled, Heat-Generating Solid, by E. M. Sparrow

**60—SA-21** Effect of Aspect Ratio and Tube Orientation on Free Convection Heat Transfer to Water and Mercury in Enclosed Circular Tubes, by F. W. Larsen and J. P. Hartnett

**60—SA-22** A Thermal Study of Composite Heat Sinks, by J. V. Beck

**60—SA-25** A Study of Free Convection Boundary-Layer Oscillations and Their Effects on Heat Transfer, by J. P. Holman, H. E. Gartrell, and E. E. Soehngen

### Human Factors—Aviation

**60—SA-34** Manual Attitude Control in Space—Arrangement of Controls, by M. L. Ritchie and L. F. Hanes

**60—SA-35** The Effect of Scale Form on the Speed and Accuracy of Scale Reading, by L. E. Wilkerson, G. A. Fox, and W. G. Matheny

**60—SA-36** Manual Control of Undamped Systems Subjected to Force-Coupled Accelerations, by P. R. Knaff

**60—SA-37** Task Performance With the CRL Model 8 Master-Slave Manipulator as a Function of Color-Coding, Distance, and Practice, by B. M. Crawford

**60—SA-38** Human Factors Evaluation of a Keyset Entry Technique for Frequency and Channel Selection, by D. E. Page and I. A. Goldberg

### Machine Design

**60—SA-1** Two-Stage Planetary Arrangements for the 15:1 Turboprop Reduction Gear, by E. A. Brass

**60—SA-2** Studies of the Design of Steel Castings and Steel Weldments as Related to Methods of Their Manufacture, by H. R. Nara, D. K. Wright, Jr., and C. W. Briggs

**60—SA-3** Design of Flapper Valves, by P. R. Paslay

**60—SA-5** Analysis and Design of Tangent Elasticity Vibration Isolators, by J. E. Ruzicka

**69—SA-6** Inspecting Taper Threads a New Technique, by A. A. Mittenbergs and Ned Rodgers

**60—SA-10** Analysis of Buckling Column Spring With Pivoted Ends and Uniform Rectangular Cross Section, by Alexander Blake

**60—SA-11** Photoelastic Model Engineering, by Herbert Becker and George Gerard

**60—SA-16** The Vibration of Shaft Ropes With Time Variable Length, Treated by Means of Riemann's Method, by W. J. Schaffers

**60—SA-17** On the Use of Clearance in Viscous Dampers to Limit High-Frequency Force Transmission, by M. E. Gurtin

### Management

**60—SA-28** Managing the Professional Employee, by W. J. Jaffe

**60—SA-29** A Method for Determining the Optimum Starting Quantity When Manufacturing to Fixed Order Size, by H. P. Goode and S. Saltzman

**60—SA-30** Motivating Subordinates to High Performance, by D. R. Yarnall, Jr.

**60—SA-31** A New Approach to Engineering Personnel Evaluation in Large Organization, by K. D. Holland

**60—SA-32** What Can an Engineer Do to Break the Communication Barrier, by E. J. DeWitt

**60—SA-33** Understanding the Creative Engineer, by H. R. Buhl

### Materials Handling

**60—SA-18** Packing and Handling of Precision Instruments, by A. Bleimeyer, Jr.

**60—SA-19** Material Handling in Maintenance Work, by J. Isenhower

### Petroleum

**60—SA-12** Stresses in Thin-Walled Pressure Vessels With Ellipsoidal Heads, by H. Kraus, G. G. Bilodeau, and B. F. Langer

**60—SA-13** An Analysis of the Yielded Compound Cylinder, by S. J. Becker

**60—SA-20** Development of a Continuous Fluid-Density Measuring Device, by G. V. Copland

**60—SA-39** A Floating Vessel Drilling and Multicompletion Method, by D. C. Guinn and R. W. Walker

### Process Industries

**60—SA-23** The Free Expansion of Dry and Moist Air, by J. H. Potter and M. J. Levy

**60—SA-24** Saline-Water Conversion and the Demonstration Plant Program, by Allen Cywin

**60—SA-26** Toward Resolution of the Chaos and Confusion in Our Systems of Units, by C. F. Kayan

**60—SA-27** Development of a Prototype for a Large Electrodialysis Cell for Treating Brackish Waters, by H. R. Drew

## Availability List—Aviation Conference

The papers in this list are available in separate copy form until April 1, 1961. Please order only by paper number; otherwise the order will be returned. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment also may be made by free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

**60—AV-1** A Systems Analysis of Fast Manned Flights to Venus and Mars, Part 1: Mission Philosophy, Life Support, Scientific Reconnaissance, and Prototype Vehicle Layout, by K. A. Ehricke

**60—AV-2** Over-All Braking for Jet Transports, by D. E. Nichols

**60—AV-3** Monorail Potential? by W. H. T. Holden

**60—AV-4** Convertiplanes in Commercial Operation, by D. E. Postle

**60—AV-5** Levacars, Why and How? by A. L. Haynes and D. J. Jay

**60—AV-6** The FAA Looks at Jet Transport Mechanisms, by H. D. Hoekstra and W. B. Spelman

**60—AV-7** Moisture Accumulation in Aircraft Soundproofing and Insulation, by J. Jensen-Gaard

**60—AV-8** Moisture Migration in an Aircraft Cabin Wall, by F. B. Bjorklund and A. C. Watson

**60—AV-9** The Development of United Air Lines' Jet Transport Galleys, by R. H. Koza and R. L. Heinrich

**60—AV-10** The DC-8 Seat—Passenger Protection With Structural Economy, by Jack Madsen

**60—AV-11** The Ducted Propeller for STOL Airplanes, by August Raspet

**60—AV-12** Fixed Wing STOL Aircraft With Distributed Suction BLC for Extended Latitude, by J. J. Cornish, III

**60—AV-13** High-Efficiency Flow Diffusion by Means of Suction Boundary-Layer Control, by I. Man Moon

**60—AV-14** Distributed Suction Boundary-Layer Control Applied to Axial Fans, by E. G. Miles

**60—AV-15** Theoretical and Experimental Investigation of a High-Performance Jet Pump Utilizing Boundary-Layer Control, by W. G. Wells

**60—AV-16** Optimized Condenser-Radiator for Space Applications, by P. C. Holden and F. C. Stump

**60—AV-17** Glass-Reinforced Plastic as an Aviation Gas-Turbine Compressor-Housing Material, by D. R. Fraser

**60—AV-18** Maintaining American Airlines' Turbojet Engines, by J. S. Mersenski

**60—AV-19** Maintenance on Pipeline Gas Turbines, by B. J. Matthews

**60—AV-20** Maintenance of Simple-Cycle Natural-Gas-Burning Gas Turbines During Ten Years' Operation in Utility Service, by J. W. Blake

**60—AV-21** Maintenance of the Bristol Proteus in BOAC's Britannia Aircraft, by J. G. Romeril

**60—AV-22** BOAC's Maintenance Experience of the Rolls Royce Avon Mark 524 in Its Comet-4 Jets, by J. G. Romeril

**60—AV-23** Mission and State-of-the-Art Effects on Rocket Feed-System Comparisons, by J. Jortner and J. K. Rosemary

**60—AV-24** Simulation Testing of Rocket Engine-Control Components, by J. R. Fenwick

**60—AV-25** Performance of the Ducted Rocket, by R. R. Kassner and F. W. Gobetz

**60—AV-26** Accomplishments in Human Simulation, by A. B. Clymer

**60—AV-27** Safety Considerations for Flight Control Systems, by Richard Hollingsworth and M. A. Ostgaard

**60—AV-28** An Experimental Sodium-Vapor Power Plant, by J. T. Congelliere, T. A. Coultas, and H. L. Burge

**60—AV-29** An Advanced Chemically Fueled Power Supply for Space Vehicles, by W. E. Wayman and A. W. Mills

**60—AV-30** An Assessment of Information on VTOL/STOL Aircraft as Applied to Commercial Transports, by Philip Donely and M. O. McKinney, Jr.

**60—AV-31** The FAA Looks at Flight Controls, by E. S. Newberger

**60—AV-32** Modular Design, by H. L. Dudley and A. M. Maher

**60—AV-33** Space Electric-Power Application Study, by H. B. Saldin and N. F. Schuh

**60—AV-34** Safety Considerations in the Design of Flight-Control Systems for Navy Aircraft, by W. R. Lomas

**60—AV-35** Possibilities for Simulation of Dynamic Physiology, by A. J. Gold

**60—AV-36** Uniform Design Criteria, by J. C. Wightman

**60—AV-37** Possibilities for Human Simulation, by A. B. Clymer and A. F. Ax

**60—AV-38** Simulation of Human Physiological Systems, by R. W. Stacy and N. A. Coulter, Jr.

**60—AV-39** Possibilities for Simulation of Human Dynamics and Perception, by A. J. Cacioppo

**60—AV-40** Accomplishments in Human Operator Simulation, by R. L. Cosgriff and G. E. Briggs

**60—AV-41** Maintenance Experience With Boeing Gas Turbine Engines, by D. F. McGrath

**60—AV-42** Structural Designer's View of Criteria Trends, by Robert Goldin

**60 AV-43** Barometric Altitude—The Problem, Solution, and Altimeter Design, by R. A. Cooper

**60—AV-44** Determination of the In-Flight Vertical, by C. E. Barkalow and H. C. Daubert

**60—AV-45** A New Fail-Safe Compensated Altimeter, by Walter Angst and James Angus

**60—AV-46** Temperature-Control System for the Atlas Able-4 Lunar Satellite, by R. M. Acker, R. P. Lipkis, and J. E. Vehrencamp

**60—AV-47** Viscous Shear Torque in Floated Gyroscopes, by J. F. Bellantoni

**60—AV-48** Air Force Maintenance on the J79 Engine, by J. H. Toeplitz

**60—AV-49** Dynamic Loads During Nose-Tow Catapulting, by Warner Lansing, W. H. Mueller, J. L. Malakoff, and Morton Mantus

**60—AV-50** The Navy Approach to the Development of Airframe Structural Design-Control Requirements, by W. H. Keen, R. L. Creel, and C. P. Baum

**60—AV-51** A Self-Stabilizing Gyro-Control System for Space Vehicles, by Sidney Godet

**60—AV-52** B.E.A.'s Experience With Propeller-Turbine Engines, by H. G. Rossiter

## The Business Meeting

THE Business Meeting of The American Society of Mechanical Engineers convened at 4:50 p.m., in the Embassy Ballroom of the Statler Hilton Hotel, Dallas, Texas, on June 6, 1960. ASME President Walker L. Cisler presided.

**1961 Summer Annual Meeting.** O. B. Schier, II, Secretary ASME, announced that the Statler Hilton Hotel in Los Angeles, Calif., has been approved as the location for the 1961 Summer Annual Meeting. The dates: June 11 to 15, 1961.

**Constitutional Amendments.** Secretary Schier reported on the letter ballot for several amendments to the constitution. (See MECHANICAL ENGINEERING, July, 1960, page 117.)

The membership approved the submission of an amendment to Article C7, Section 5 of the Constitution. The proposed change, which will be submitted to the membership for letter ballot, modifies the procedure for filling a vacancy in the office of President. In the event of such a vacancy, the Council would be called into session within one month for the purpose of electing a President from among its elected members to fill the unexpired term. Under the present provision the office of President would automatically be filled by the Vice-President having the longest consecutive service as Vice-President.

The members and alternates of the 1961 Regular Nominating Committee were elected. (See page 127, this issue.)

President Cisler then reported briefly on progress in unity of the engineering profession and called attention to the ASME Advisory Committee on Unity and the action taken by the Council at its meeting. (See page 134, this issue.)

Mr. Cisler also reported on the progress of the United Engineering Center and the status of the ASME Member Gifts Campaign. (See Editorial page 33 and President Cisler's address, pages 36–38, in this issue.)

## ASME Applied Mechanics Division Holds 23rd National Conference at Penn State

THE twenty-third National Conference of the Applied Mechanics Division of The American Society of Mechanical Engineers took place June 20–22, 1960, at The Pennsylvania State University, in the mountain country of Central Pennsylvania. The Conference, staged with the co-operation of ASME's Central Pennsylvania Section, encompassed six technical sessions at which 32 technical papers were presented.

What are the applied-mechanics engineers working on? Plates and shells (typical paper: An Approximate Analysis of the Influence of Aerodynamic Heating and Initial Twist on the Torsional Stiffness of Thin Wings). Shells (typical paper: On Strain-Hardened Circular Cylindrical Shells).

One session was devoted to Elasticity —Thermal Stress (Transient and Residual Thermal Stress in an Elastic-Plastic Cylinder). Then came Plasticity—Creep (Prediction of Creep-Failure Time for Pressure Vessels).

On the last day of the Conference, the sessions took up Vibration—Dynamics, and Bearings—Stability—Fluid Mechanics (typical paper: A Study of the Stability of Externally Pressurized Gas Bearings).

**Getting Together.** The first day ended with an informal party in the lounge of Penn State's Hetzel Union Building, named for the man who was President of the University from 1926 to 1947. On the evening of the second day, there was a reception at the Centre Hills Country Club, followed by the banquet at which Hugh L. Dryden, Fellow ASME and Deputy Administrator of the National Aeronautics and Space Administration (NASA), was the speaker.

Dr. Dryden's speech, "The Exploration of Space," will appear as a feature article in a later issue of MECHANICAL ENGINEERING. He pointed out that the exploration of space actually began centuries ago, when early-day astronomers began to interpret their observations. Today we think of the exploration of space as having begun on Oct. 4, 1957, when the first artificial satellite went into orbit—and into the headlines. Now we have the National Aeronautics and Space Administration to implement our government's policy that "activities in space should be devoted to peaceful purposes for the benefit of all mankind."

The specific national objectives are: To gain new scientific knowledge; the early application of earth satellites to immediately practical uses for human benefit (weather observation, long-range radio communication); and to begin the exploration of space by man.

"It is expected," he said, "that a suborbital or ballistic flight of man will be accomplished during the present calendar year, and orbital flight in calendar year 1961."

After that, the specific objective will be a manned flight around the moon and return to earth, a goal which seems possible near the end of this decade. However, the results of the upcoming Project Mercury will greatly affect the course and pace of manned space flight. Not until man has actually experienced weightlessness for several hours will we know how he can perform in space.

NASA is charged with the responsibility for the conduct of aeronautical research necessary to the continued advancement of both civilian and military aviation.

"Space technology," said Dr. Dryden, "provides a powerful stimulus to rapid engineering advance with countless byproducts to all branches of science and technology, and thus to our whole industrial and social system. Because of these factors, space accomplishment has become in the minds of many a symbol of a nation's stature in all science and engineering . . . an important element in the assessment of national prestige by the world community."

## Availability List—Applied Mechanics Conference

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**60—APM-1** Rupture Instability of Plane Membranes and Solids, by S. F. Borg

**60—APM-2** The Junction Problem of Solid-Slotted Cylindrical Shells, by D. H. Cheng and N. A. Weil

**60—APM-3** Extensional Vibrations and Waves in a Circular Disk and a Semi-Infinite Plate, by D. C. Gazis and R. D. Mindlin

**60—APM-4** Transient and Residual Thermal Stresses in an Elastic-Plastic Cylinder, by H. G. Landau and E. E. Zwicky, Jr.

**60—APM-5** A Study of the Stability of Externally Pressurized Gas Bearings, by Lazar Licht and Harold Elrod

**60—APM-6** The Vibration Response of a Linear Undamped System Resting on a Nonlinear Spring, by P. R. Paslay and M. E. Gurtin

**60—APM-7** Prediction of Creep-Failure Time for Pressure Vessels, by F. P. J. Rimrott, E. J. Mills, and Joseph Marin

**60—APM-8** Sinusoidal Excitation of a System With Bilinear Hysteresis, by T. K. Caughey

**60—APM-9** Stability of a Turbine-Generator Rotor Including the Effects of Certain Types of Steam and Bearing Excitations, by A. H. Landzberg

**60—APM-10** Note on the Assessment of Flow Disturbances at a Blunt Body Traveling at Supersonic Speeds Owing to Flow Disturbances in Free Stream, by M. V. Morkovin

**60—APM-11** On Saint Venant's Principle: Elastic Shells and Plates, by P. M. Naghdi

**60—APM-12** On Three and Two-Dimensional Disturbances of Pipe Flow, by Kurt Spielberg and Hans Timan

**60—APM-13**—An Approximate Analysis of the Influence of Aerodynamic Heating and Initial Twist on the Torsional Stiffness of Thin Wings, by L. S. Han

**60—APM-14** On the Airy Stress Functions of Plane Dislocation Problems, by F. D. Ju

**60—APM-15** Forced Lateral Vibration of a Uniform Cantilever Beam With Internal and External Damping, by H. C. Lee

**60—APM-16** The Effect of Pressure on the Bending Characteristics of an Actuator System, by Paul Seide

**60—APM-17** Buckling of Circular Cones Under Axial Compression, by Leslie Lackman and Joseph Pensien

**60—APM-18** Modeling of Large Transient Elastic and Plastic Deformations of Structures Subjected to Blast Loading, by W. E. Baker

**60—APM-19** On the Theoretical Analysis of Dynamic Thermocouple: Part 2—The Continuous Area Interface, by W. F. Hughes and E. W. Gaylord

**60—APM-20** On Strain-Hardened Circular Cylindical Shells, by Nicholas Perrone and P. G. Hodge, Jr.

**60—APM-21** Stresses in Curved Beams of Noncircular Center Line, by M. M. Abbassi

**60—APM-22** The Elastoplastic Thick-Walled Sphere Subjected to a Radial Temperature Gradient, by G. R. Cowper

**60—APM-23** Shock Spectra of a Nonlinear System, by W. T. Thomson

**60—APM-24** Transient Conduction in Coaxial Cylinders With Relative Motion and Heat Generation, by V. S. Arpaci

**60—APM-25** A Method for Investigating Certain Eigenvalue Problems of the Buckling and Vibration of Plates, by H. D. Conway and A. W. Leissa

**60—APM-26** Elastic Instability of Rectangular Sandwich Panel of Orthotropic Core With Different Face Thicknesses and Materials, by C. C. Chang and I. K. Ebcioglu

**60—APM-27** Two-Dimensional Gas Jets, by M. J. Cohen

**60—APM-28** Thermoelastic Stresses in Beams, by E. S. Barrekette

**60—APM-29** Dynamical Response of an Elastic Half-Space to Tangential Surface Loadings, by Chi-Chang Chao

**60—APM-30** Thermal Transfer in Turbulent Gas Streams. Effect of Turbulence on Local Transport From Spheres, by W. W. Short, R. A. S. Brown, and B. H. Sage

**60—APM-31** Plastic Analysis of Circular Conical Shells, by P. G. Hodge, Jr.

## Availability List—West Coast Applied Mechanics Conference

The papers in this list, which were presented at the West Coast Conference of Applied Mechanics, June 27–29, at California Institute of Technology, are available in separate copy form until April 1, 1961. Please order only by paper number; otherwise the order will be returned. You can save the postage and handling charges by including your check or money order payable to ASME with your order and sending both to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members. 80 cents to nonmembers. Payment also may be made by free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

**60—APMW-1** Random Excitation of a Loaded Nonlinear String, by T. K. Caughey

**60—APMW-2** Expansion of Thick-Walled Cylinders Fabricated From Cold Bent Plates, by Irwin Berman

**60—APMW-3** The Additional Deflection of a Cantilever Due to the Elasticity of the Support, by W. J. O'Donnell

**60—APMW-4** Stress Distributions Analyzed in Bispherical Co-Ordinates, by T. P. Mitchell and J. A. Weese

**60—APMW-5** Effect of Small Hub-Radius Change on Bending Frequencies of a Rotating Beam, by Hsu Lo, J. E. Goldberg, and J. L. Bogdanoff

**60—APMW-6** Thermal Stresses Due to Disturbance of Uniform Heat Flow by an Insulated Ovaloid Hole, by A. L. Florence and J. N. Goodier

**60—APMW-7** On a Class of Nonlinear Axisymmetric Plate Problems, by F. Essenburg

**60—APMW-8** Thermal Stresses in an Elastic, Work-Hardening Sphere, by Chintsun Hwang

**60—APMW-9** On the Response of an Elastic Half-Space to a Moving Blast Wave, by J. W. Miles

**60—APMW-10** The Elastic Half Plane Subjected to Surface Tractions With Random Magnitude or Separation, by A. C. Eringen and J. W. Dunkin

**60—APMW-11** Flexural Stress Waves in an Infinite Elastic Plate Due to a Suddenly Applied Concentrated Transverse Load, Julius Miklowitz

**60—APMW-12** Free, Transverse Vibrations of a Solid Elastic Mass in an Infinitely Long Rigid, Circular-Cylindrical Tank, J. H. Baltrukonis

**60—APMW-13** The Propagation of an Impulse Into a Viscous-Locking Medium, by J. W. Miles

**60—APMW-14** The Bending Stress Distribution at the Base of a Stationary Crack, by M. L. Williams

**60—APMW-15** Some Gyroscopic Oscillations by C. J. Thorne

# Engineering Management Conference to Be Held in Chicago, Sept. 15-16

The 1960 Engineering Management Conference planned by seven professional engineering societies, including ASME, ASCE, AIME, AIEE, AIChE, IRE, AIIE, and EIC for managers of technical work, or those preparing for such management positions, covers four basic areas, and will be held Sept. 15-16, at the Morrison Hotel in Chicago, Ill.

First session is designed to provide background information on "Impinging Forces," those influences that will shape tomorrow's management decisions. Economic competition, domestic and foreign, availability and cost of raw materials and labor, effect of foreign grade alliances such as the European common market, tariffs, and other government policies—all will be explored and interpreted in terms useful to engineering managers. The need for technological progress in areas other than weapons, and its importance for economic survival will also be discussed.

Speaker for the Thursday luncheon is Clarence H. Linder, Mem. ASME, vice-president and group executive—Electric Utility Group, General Electric Company, New York, N. Y., and AIEE President. His subject is "Making the Commitment to Change;" the answer to competition from any source—including technology itself—is timely innovation. Innovation demands leading-edge skill at knowing what is feasible; at knowing what is wanted; and at decision making, including the choice of objectives, the planning and organizing of effort, and the measurement of results.

The second session will cover "New Requirements and New Aids of Managers." This is planned to outline new demands on managers in the fields of forecasting, planning, scheduling, organizing, integrating, and measuring technical work as well as major advances in the use of data processing machines to study alternatives and support managerial judgment.

### Availability of Papers

Technical papers listed in the program will be available at the conference. After the conference, papers may be ordered from AIEE headquarters, 50 cents for members and $1 for nonmembers of the sponsoring organizations.

The third session will discuss "Impact on Professional People." This will bring out the continuing trends toward more brain work and less muscle work by men, more repetitive work by machines and less by men, longer range and more detailed planning, scheduling, integration, and measuring required by increasing complexity, interrelated effects, and economic impacts of mechanization and automatic machine production.

Speaking at the Friday luncheon will be Jerry E. Morse, vice-president, Minneapolis-Honeywell Regulator Company, South Minneapolis, Minn., whose subject will be "Engineering Management in the Years Ahead." The increasing pace and complexity of technological development are paralleled in the development of engineering management. The responsibility for the supervision of professional personnel has been an increasingly difficult and challenging one. Accomplishment in the future will be dependent as much on the understanding and skill in handling professional personnel as upon the understanding and skill in handling the technology itself. Engineers who expect to have management responsibilities in the future will be interested to hear the discussion of this subject.

The final session will discuss the "Impact on Education." This should bring out implications for all engineers who are in or aspire to positions as managers of technical work. This will include the impacts on technical schools, business schools, and also on continued postgraduate and home study. In these times of rapid technological change, self-education can never cease for one who plans to continue to grow into larger responsibilities.

A banquet is scheduled to begin at 7:00 p.m., the principal speaker to be P. F. Drucker of Montclair, N. J. His talk entitled "Managing Tomorrow," will deal with organized work on management and organized study of its nature and function, begun just about 50 years ago. In these five decades we have made giant steps in all four areas of concern to the manager and of the society in which he lives; namely, management science, human organization, and management as a world-wide resource.

The women's program on Thursday includes luncheon and a trip to the Museum of Science and Industry. Scheduled for Friday are breakfast at Don McNeill's Breakfast Club, and a luncheon and style show at the Kungsholm Restaurant.

### ▶ THURSDAY, SEPTEMBER 15

#### Session 1—Impinging Forces 9:35 a.m.

**The Economic Forces Shaping Business Policy,** by *Ralph Burgess*, chief economist, American Cyanamid Co., New York, N. Y.

**Impact of Technological Progress on Tomorrow's Management,** by *E. T. Green*, executive vice-president, Bell Telephone Lab., Inc., Murray Hill, N. J.

**Social and Political Forces Impinging on Engineering Management—or, Who Really Makes the Decisions and Why,** by *C. C. Furnas*, Chancellor, The Univ. of Buffalo, Buffalo, N. Y.

#### Session 2—New Requirements and New Aids for Managers 2:30 p.m.

**Mobilization of Data and Information for Technical and Management Decisions,** by *J. S. Sayer*, general manager, Documentation, Inc.

**Engineers and Computists,** by *W. A. Smith, Jr.*, director, Computing Lab, Lehigh Univ., Bethlehem, Pa.

**Statistics as an Aid to Engineering,** by *H. L. Jones*, professor of statistics, Graduate School of Business, Univ. of Chicago, Chicago, Ill.

### ▶ FRIDAY, SEPTEMBER 16

#### Session 3—Impact on Professional People 9:30 a.m.

**The Engineer's Participation in the Company, and in the Community,** by *H. F. Smiddy* vice-president, Management Consultation Services, Gen. Elec. Co., New York, N. Y.

**Social Change in Science and Engineering,** by *H. A. Shepard*, professor of behavioral science, Case Inst. of Tech., Cleveland, Ohio

#### Session 4—Impact on Education 2:30 p.m.

**Education and Development of Engineers as Managers at Insland Steel Company—A Company Experience,** by *H. W. Johnson*, vice-president, Planning and Research, Insland Steel Co., Chicago, Ill.

**More Management or Less?** by *K. B. McEachron, Jr.*, dean of instruction, Case Inst. of Tech., Cleveland, Ohio

**An Industrial Problem Centered Student Development Program,** by *C. L. Tutt, Jr.*, administrative chairman, Fifth-Year Thesis and Graduate Study Programs, Gen. Motors Inst., Flint, Mich.

## ASME Petroleum Conference in New Orleans Offers an Important Program

The 15th annual conference of the Petroleum Division of The American Society of Mechanical Engineers to be held September 19 through 21 at the Jung Hotel, New Orleans, La., offers a "custom-made" program that few petroleum men can afford to miss.

The technical program, to be presented in 26 sessions, schedules more than fifty papers as well as inspection trips to land and sea installations and panel discussions on the ASME Unfired Pressure Vessel Code and the ASA B31.3 Piping Code. The program has been a year in the making and is planned to meet the needs of mechanical and other engineers in the petroleum industry.

A glance at the technical program clearly gives evidence of the care that went into the preparation for the conference. While the social program was noted (see Mechanical Engineering, July, 1960, page 108) in passing, it was planned with equal attention to detail. Moreover, can anyone deny the charm of New Orleans? All this and interesting as well as important petroleum operations to see make for what promises to be a not-to-be-missed event of 1960.

### ▶ MONDAY, SEPTEMBER 19

#### Session 1—Today's Compressors—Construction and Maintenance 9:00 a.m.

**Refining, Gas Products, Petrochemical**

**Maintenance of Turbocharged Engines Including Large and Medium-Sized Units in Gas Transmission,** by *J. H. Caldwell*, Cooper-Bessemer Corp., Los Angeles, Calif.

**Gas Engine and Gas-Turbine Prime Movers,** by *R. F. Moser*, Reciprocating Products Div., Clark Bros., Olean, N. Y., and *C. W. Walker, Jr.*, Richfield Oil Corp., Bakersfield, Calif.

#### Session 2—Design Problems 9:00 a.m.

**Refining, Gas Products, Petrochemical**

**High-Temperature Stability of Tubular Products for Oil-Refinery Use,** by *A. B. Wilder* and *D. T. Boughner*, U. S. Steel Corp., Pittsburgh, Pa., and *E. F. Ketterer* and *D. B. Collyer*, U. S. Steel Corp., Lorain, Ohio

**Design Against Excessive Plastic Deformation,** by *W. P. Kerkhof*, Bataafs Internationale Petroleum, Maatschappij, N. V. (Paper No. 60—Pet-2)

#### Session 3—Research 9:00 a.m.

**Drilling and Production**

**You Too, Can Be a Creative Engineer,** by *C. R. Hocott*, Humble Oil & Refining Co., Houston, Texas (Paper No. 60—Pet-8)

**Hydraulic Wall-Anchored Drill Collar,** by *J. M. Kellner* and *A. P. Roberts*, Jersey Production Research Co., Tulsa, Okla.

#### Session 4—Oil and Gas Pipeline Equipment 9:00 a.m.

**Transportation**

**Modern Developments of Centrifugal Pumps,** by *C. Bartolero* and *E. E. Lindros*, Byron Jackson Div., Borg Warner Corp., Los Angeles, Calif.

**Use of Turbine-Type Meters for Pipeline Metering,** by *W. W. Holt, Jr.*, Plantation Pipe Line Co., Atlanta, Ga.

**Design Data for Pipeline-Branch Connections,** by *T. J. Atterbury* and *G. M. McClure*, Applied Mechanics Div., Battelle Memorial Inst., Columbus, Ohio

#### Session 5—Drilling and Production 2:30 p.m.

**Materials**

**The Constructional Steels and Their Application in the Petroleum Industry,** by *J. A. Gilligan*, U. S. Steel, Monroeville, Pa., and *R. D. Webb* and *J. R. England*, U. S. Steel, Pittsburgh, Pa.

**Use of Computers for Solving Petroleum-Engineering Problems,** by *W. S. Pickrell*, IBM Corp., Houston, Texas

**Evaluation of Glass Reinforced Plastic Pipe,** by *R. M. Levy*, Esso Research & Engineering Co., Madison, N. J.

#### Session 6—Refinery Design Problems 2:30 p.m.

**Continuous Corrosion Monitoring With Corrosion Probes,** by *A. S. Couper*, *E. S. Troscinski*, and *A. Dravnieks*, Standard Oil Co., Whiting, Ind. (Paper No. 60—Pet-7)

**Some Results on Continuously Drilled Fixed Tube Plates,** by *G. D. Gallently*, Shell Development Co., Emeryville, Calif., and *D. R. Snow*, Stanford Univ., Stanford, Calif. (Paper No. 60—Pet-16)

#### Session 7—Engineering Design—Techniques 2:30 p.m.

**Refining, Gas Products, Petrochemical**

**Utilization of Photography in Plant Engineering,** by *R. J. Tiller*, Monsanto Chemical Co., St. Louis, Mo.

**Photography for Plant Engineering,** by *C. B. Hammond*, Monsanto Chemical Co., Springfield, Mass.

**Models—A Basic Tool in Process-Plant Design,** by *D. J. Fries*, Foster Wheeler Corp., New York, N. Y. (Paper No. 60—Pet-3)

### Session 8—Equipment Design Economics 2:30 p.m.

#### Drilling and Production

**How Economics Influenced the Design of a 15,000-Pound Working-Pressure Blowout Preventer,** by *R. C. Brooks*, *G. E. Nevill*, and *Herbert Allen*, Cameron Iron Works Co., Houston, Texas

**Oil-Well Tubing Joints,** by *H. M. Banta*, U. S. Steel Corp., Pittsburgh, Pa.

### Session 9—Encouragement of Creativity by Company Policy With Regard to Patents, Royalties, Etc. 2:30 p.m.

#### Manufacturing
#### Panel Discussion: Creativity

*D. Lewis Shuker*, Psychological Testing Service, Baton Rouge, La.; *Charles Lightfoot*, Houston, Texas; *Art Wintringham*, Ethyl Corp., Baton Rouge, La.; and *Jack Hayden*, of Hayden & Pravel, Houston, Texas

## ▲ TUESDAY, SEPTEMBER 20

### Session 10—Gas Pipelines 9:00 a.m.

#### Transportation

**Noise-Abatement Methods in Meter and Regulator Stations,** by *W. F. Kienast*, Houston Texas Gas and Oil Co., St. Petersburg, Fla.

**Design Application of Gas-Engine Driven Balanced Opposed Compressors for Pipeline and Process Installations,** by *W. M. Kauffmann*, Compressor and Engine Div., Worthington Corp., Buffalo, N. Y. (Paper No. 60—Pet-14)

**Fuels for Argentina—Pipeline to Prosperity,** by *J. C. Cannan*, Fish Engineering Corp., Houston, Texas

### Session 11—Mechanical Features of New Plants 9:00 a.m.

#### Refining, Gas Products, Petrochemical

**Sulfur Recovery From Petroleum Gases,** by *R. M. Graff*, Graff Engineering Co., Dallas, Texas

**Automatic Vapor-Pressure Controller for Optimum Volatiles Injection Into Crude Streams,** by *P. Scott*, Shell Pipeline Corp., Houston, Texas

### Session 12—Engineering Design—Stress Analysis 9:00 a.m.

#### Refining, Gas Products, Petrochemical

**Stress Analysis of a Cylindrical Shell Ring Stiffener,** by *I. M. Daniel*, Armour Research Foundation, Chicago, Ill.

**The Effects of Internal Pressure on Thin Shell Pressure-Vessel Heads,** by *E. C. Jones, Jr.*, Auburn Univ., Auburn, Ala.

### Session 13—Drilling 9:00 a.m.

#### Drilling and Production

**Pipe Stresses When Drilling From a Floating Vessel,** by *E. R. Lind*, Standard Oil Co. of California, San Francisco, Calif.

**The Mechanical Aspects of Rig Moves,** by *M. T. Parker*, Great Western Drilling Co., Midland, Texas (Paper No. 60—Pet-4)

### Session 14—Numerical Control and Statistical Techniques 9:00 a.m.

#### Manufacturing

**Graphical Solution to Some Selected Statistical Distributions,** by *C. E. Lewis*, Cook Heat-Treating Co., Houston, Texas (Paper No. 60—Pet-9)

**Are You Considering Numerical Control?** by *J. A. Baker*, Gen. Elec. Co., Waynesboro, Va. (Paper No. 60—Pet-1)

### Session 15—Panel Session: ASME Unfired Pressure Vessel Code 2:30 p.m.

#### Refining, Gas Products, Petrochemical

Panel Members: *G. S. Chadwick, Jr.*, Union Carbide & Chemical Co., South Charleston, W. Va.; *G. E. Fratcher*, A. O. Smith Corp., Milwaukee, Wis.; *N. J. Rees*, Mobil Oil Co., New York, N. Y.; *F. S. G. Williams*, Taylor Forge & Pipe Works, Chicago, Ill.; and *L. P. Zick*, Chicago Bridge & Iron Works, Chicago, Ill.

### Availability of Papers

ONLY numbered ASME papers in this program are available in separate copy form until July 1, 1961. Prices are 50 cents to members of ASME, $1 each to nonmembers, plus postage and handling charges. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and send both to ASME Order Department, 29 West 39th Street, New York 18, N. Y. Payment also may be made by free coupons, or coupons which may be purchased from the Society in lots of ten at $4 to members; $8 to nonmembers. Papers must be ordered by the paper number listed in this program; otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

### Session 16—Well Services 2:30 p.m.

#### Drilling and Production

**New Machines Improve Depth Accuracy,** by *W. E. Bowers*, Schlumberger Well Surveying Corp., Houston, Texas (Paper No. 60—Pet-5)

**Radioactive Measurement of Fluid Density,** by *D. G. Hartweg*, Dowell Div., Dow Chemical Co., Tulsa, Okla.

**Correlation of a New Design Concept for a High-Horsepower Reciprocating Pump With Test Stand and Field Results,** by *F. C. Christ*, BJ Services, Inc., Long Beach, Calif.

### Session 17—Recent Developments in the Application of Aluminum and in Dry Film Lubrication 2:30 p.m.

#### Manufacturing

**Aluminum in the Petroleum Industry,** by *P. E. Brandt* and *R. W. Flourney*, Reynolds Metal Co., Richmond, Va. (Paper No. 60—Pet-1)

**Solid Film—Lubricants for Extreme Environments,** by *R. J. Bensing*, Wright Air Development Div., USAF, Dayton, Ohio, and *C. F. Merrill*, Fluids and Films Sections, Materials Lab., WADD, Long Beach, Calif. (Paper No. 60—Pet-10)

### Session 18—Oil Pipelines 2:30 p.m.

#### Transportation

**A Computer Program to Determine the Throughput Rate of a Heated Pipeline,** by *Dennis Horner* and *P. Fried*, Bataafse International Petroleum Maatschappij, The Hague, The Netherlands

**Computer Simulation of Marine Terminal and Pipeline Operations of the Trans-Arabian Pipe Line Company,** by *D. W. Dreier*, Trans-Arabian Pipe Line Co., Van Cortlandtville, N. Y., and *B. A. Sachs*, Esso Research & Engineering, Florham Park, N. J.

### Session 19—Refining, Gas Products, Petrochemical 2:30 p.m.

#### Materials

**Austenitic Cast Irons in the Petroleum Industry,** by *T. P. May*, The International Nickel Co., Inc., Wrightsville Beach, N. C., and *J. F. Mason, Jr.*, The International Nickel Co., New York, N. Y.

**Bi-Metallic Pipe,** by *Dan Christopher*, Gray Tool Co., Houston, Texas

**The Use of Copper-Alloy Tubes in the Petroleum Industry,** by *E. J. Duffy*, Scovill Mfg. Co., Waterbury, Conn.

## ▶ WEDNESDAY, SEPTEMBER 21

### Session 20—Supervisory Development 9:00 a.m.

#### Refining, Gas Products, Petrochemical

**The Profession of Management,** by *W. E. Bennett*, Cities Service Refining Co., Lake Charles, La.

**Rate Your Supervision—A Program for Supervisory,** by *P. W. Maloney*, Esso Research & Engineering Co., Linden, N. J.

### Session 21—Production 9:00 a.m.

#### Drilling and Production

**New Developments in Surface and Subsurface Storm Chokes,** by *P. S. Sizer* and *W. W. Dollison*, Otis Engineering Corp., Dallas, Texas

**Hollow Rod Pumping in Slim Hole Completions,** by *W. D. Shannon*, Stekoll Petroleum Corp., Dallas, Texas

### Session 22—Metal Forming 9:00 a.m.

#### Manufacturing

**Modern Explosive Metal Forming,** by *R. A. Cooley*, Chromaloy Co., Edwardsville, Ill.

**Practical Aspects of the Heat-Treatment of High-Speed Steels,** by *Dale McKissick*, Reed Roller Bit Co., Houston, Texas (Paper No. 60—Pet-11)

**Cemented Oxide Cutting Tools,** by *Grant Morrison*, Gen. Elec. Co., Detroit, Mich. (Paper No. 60—Pet-12)

### Session 23—Oil and Gas Pipeline Automation 9:00 a.m.

#### Transportation

**An Automatic Control System for a Pipeline Compressor Station,** by *L. R. Henry, Jr.*, and *K. S. Hagius*, Colorado Interstate Gas Co., Colorado Springs, Colo. (Paper No. 60—Pet-15)

**Automation for Liquid Pipelines,** by *J. F. Stephenson*, Gulf Oil Corp., Pittsburgh, Pa. (Paper No. 60—Pet-6)

**Supercompressibility Factors for Gas Pipeline-Measurement Automation,** by *Ed Gordon*, United Gas Corp., Shreveport, La.

### Session 24—Transportation 9:00 a.m.

#### Materials

**Ultrasonic Testing,** by *C. E. Lautzenheiser*, Dow Chemical Co., Freeport, Texas

**The Use of Thin Wall Line Pipe in the Oil and Gas Industry,** by *W. P. Heineman*, United Gas Pipe Line Co., Shreveport, La.

### Session 25—Panel Session: ASA B31.3 Code for Refinery Piping 2:30 p.m.

#### Refining, Gas Products, Petrochemical

Panel Members: *D. W. Motter*, Esso Research and Engineering Co., Madison, N. J.; *D. R. Loper*, Standard Oil of California; *W. H. Skewis*, Gulfport Piping Co., Gulfport, Miss.; *D. K. Greenwald*, Ladish Co., Cudahyladish, Wis.; *S. J. Arteses*, Shell Oil Co., New York, N. Y.; *H. M. Howarth*, Standard of Indiana, Whiting, Ind.; *J. P. Mooney*, Humble Oil & Refining Co., Baytown, Texas; and *F. S. G. Williams*, Taylor Forge Pipe Works, Chicago, Ill.

### Session 26—Gas and Oil Handling 2:30 p.m.

#### Drilling and Production

**The Design of Semi-Permanent Gas-Compressor Stations,** by *J. L. Joplin*, Oil & Gas Supply Co., and Texas Pump & Compressor Co., Houston, Texas

**General Aspects of Offshore Automation,** by *W. J. Rapson, Jr.*, Garrett Oil Tools, Longview, Texas

**Recent Developments in Field Gas-Handling Facilities,** by *H. R. Galloway*, Humble Oil & Refining Co., Houston, Texas, *R. R. Die*, Humble Oil & Refining Co., Corpus Christi, Texas; and *W. D. Clift*, Humble Oil & Refining Co., New Orleans, La.

# Philadelphia to Be Host to 1960 ASME-AIEE National Power Conference

The forthcoming National Power Conference sponsored by two of the nation's leading engineering societies, The American Society of Mechanical Engineers and the American Institute of Electrical Engineers, will be held in Philadelphia, Pa., Sept. 21–23, 1960, at the Bellevue-Stratford Hotel. The Conference, which will cover the problems of power generation and transmission, is expected to attract more than 800 engineers and executives concerned with power generation for either utility companies or industrial plants.

In addition to 20 technical papers in such fields as co-ordinating generation and transmission of power, service requirements for industrial companies, advancement of power engineering, and automation of power plants, the Conference will offer inspection trips to the Switchgear Factory and Laboratory of the General Electric Company, Turbine and Heat-Transfer Facilities of the Westinghouse Electric Corporation, and the Eddystone Plant of the Philadelphia Electric Company. The Eddystone Plant is generally considered the last word in high-temperature, high-pressure power generation.

High lights of the meeting will be the presentation of the ASME George Westinghouse Medal to E. C. Gaston, president of Southern Services, Inc., Birmingham, Ala., for outstanding achievement in the power field, and the 1960 Prime Movers Committee Award, jointly to Sigmund N. Fiala of New York and James H. Harlow, of Philadelphia, for outstanding contributions to the literature of thermal electric station practice or equipment.

Rounding out the technical program will be luncheons on Wednesday and Thursday, September 21 and 22, with a banquet on Thursday evening. The banquet committee has been fortunate in securing, through the courtesy of General Motors Corporation, Detroit, Mich., a prominent speaker in Dr. Carl S. Winters, leader in the field of juvenile crime prevention, renowned writer, traveler, and who for the past 20 years has directed The First Baptist Church of Oak Park, Ill. Complementing the social events program are several enjoyble events planned for the women guests.

## Availability of Papers

### ASME Papers By Mail

Only numbered ASME papers in this program are available in separate copy form until July 1, 1961. Prices are 50 cents to members of ASME, $1 to nonmembers, plus postage and handling charges. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and send both to ASME Order Department, 29 West 39th Street, New York 18, N. Y. Payment also may be made by free coupons or coupons which may be purchased from the Society in lots of ten at $4 to members; $8 to nonmembers. Papers must be ordered by the paper numbers listed in this program; otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the Conference.

### AIEE Papers By Mail

Copies of AIEE papers can be obtained by writing directly to the American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N. Y. Prices are 50 cents to members and $1 to nonmembers. Papers must be ordered by the paper numbers listed in this program; otherwise the order will be returned.

### ▶ WEDNESDAY, SEPTEMBER 21

#### Session 1—Co-ordination of Generation and Transmission and Operation 9:00 a.m.

**Integrated Planning for 5-State Rocky Mountain Area,**[2] by *R. F. Walker*, Public Service Co. of Colorado, Denver, Colo.; *R. A. Tynes*, Public Service Co. of New Mexico, Albuquerque, N. Mex.; *D. L. Bryner*, Utah Power and Light Co., Salt Lake City, Utah; and *W. H. Croft*, Arizona Public Service Co., Phoenix, Ariz.

**Co-ordination of Generation and Transmission Planning on the General Public Utilities System,**[2] by *R. W. Werts*, Gen. Public Utilities Co. System, Reading, Pa.

**Integration of Generation and Transmission in System Planning,**[2] by *A. G. Mellor*, *H. O. Simmons, Jr.*, and *L. K. Kirchmayer*, Gen. Elec. Co., Schenectady, N. Y.

**Electric Generating Stations of Public Service Electric and Gas Company 1930 to 1960,**[2] by *R. A. Baker*, Public Service Elec. and Gas Co., Newark, N. J.

#### Session 2—Service Requirements for Industrial Customers 2:00 p.m.

**Industry's Need for Quality Electric Power Service,**[1] by *R. W. Worley*, United Engineers and Contractors, Inc., Philadelphia, Pa.

**What the Chemical Industry Can Do to Minimize Effects From Disturbances,**[2] by *M. Gilbert*, E. I, du Pont de Nemours and Co., Inc., Wilmington, Del.

**Supply of Electric Service to an Integrated Steel Plant,**[2] by *H. Halstead* and *H. D. Ruger*, Bethlehem Steel Co., Sparrow Point, Pa.

**What Utilities Are Doing to Provide Quality Service,**[2] by *L. V. Dugas* and *Y. L. Hughes*, Gulf-States Utilities Co., Beaumont, Texas

#### Session 3—Advancement of Power Engineering 8:00 p.m.

##### Panel Presentation

**Problems Utility Engineers Will Face 20 Years Hence,** by *J. H. Foote*, Commonwealth Associates, Inc., Jackson, Mich.

**Problems Industrial Power Systems Engineers Will Face 20 Years Hence,** by *J. C. O'Connor*, McGraw-Hill Book Co., Inc., New York, N. Y.

**How Best to Train People to Meet These Problems,** by *E. T. B. Gross*, Illinois Inst. of Tech.

### ▶ THURSDAY, SEPTEMBER 22

#### Session 4—Power-Plant Automation 9:00 a.m.

**General Philosophy and Objectives of Power-Plant Automation,**[2] by *W. L. Chadwick*, Southern Calif. Edison Co., Los Angeles, Calif.

**The Systems Approach to a Computer-Controlled Generating Plant,**[2] by *L. F. Kennedy*, Gen. Elec. Co., Schenectady, N. Y., and *A. M. Spielberg*, Gen. Elec. Co., Phoenix, Ariz.

**Automation—The Application of Computers to Automatic Boiler Operation,** by *G. W. Kessler*, The Babcock & Wilcox Co., Barberton, Ohio (ASME Paper No. 60—Pwr-1)

**Steam Turbine-Generator Automation,**[1] by *E. G. Noyes* and *J. D. Davidson*, Westinghouse Elec. Corp., Philadelphia, Pa.

#### Session 5—Power-Plant Automation 2:00 p.m.

**Experience With Remote Burner Systems,**[1] by *R. H. Forney*, Forney Engineering Co., Dallas, Texas

**A Digital Computer and Input Requirements for Unit-Performance Calculations,**[2] by *T. W. Jenkius, Jr.*, and *I. A. Kunzman, Jr.*, Leeds and Northrup Co., Philadelphia, Pa.

**Computer Application to Power-Plant Automation,**[2] by *F. W. Lyle*, Daystrom, Inc., La Jolla, Calif.

**Organization and Administration of Automated Power Plants,**[1] by *W. T. Hess*, Louisiana Power and Light Co., New Orleans, La.

### ▶ FRIDAY, SEPTEMBER 23

#### Session 6—Advancements in Economic Power Production 9:00 a.m.

**Code Testing of Large Boilers: Input-Output or Heat-Loss Method,**[1] by *J. A. Bostic* and *W. F. Long*, Cleveland Elec. Illuminating Co., Cleveland, Ohio

**A Look at Big-Power Cycles for 40 Per Cent Thermal Efficiency or Better,**[1] by *P. H. Knowlton, Jr.*, Gen. Elec. Co., Schenectady, N. Y.

**Thermal Stress Protection in Starting and Loading Boiler-Turbine-Generator Combinations,**[1] by *R. H. Reisinger* and *C. B. Scharp*, Baltimore Gas and Electric Co., Baltimore, Md.

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[2] AIEE Paper not available—see box on this page.

[1] ASME Paper not available—see box on this page.

# ASME-AIME Solid Fuels Conference, October 24–25

The first national Solid Fuels Conference ever conducted in West Virginia will be held in Charleston at the Daniel Boone Hotel on Oct. 24–25, 1960. This 23rd annual ASME-AIME Joint Solid Fuels Conference will highlight "Economics in the Production and Utilization of Coal" as this year's theme.

West Virginia's Governor Cecil H. Underwood has accepted the invitation to be the principal banquet speaker on Monday evening, Oct. 24, 1960.

The program for this year's annual meeting includes topics such as "What Utilities and Industrial Plants Look for in Purchasing Coal," and "The Supplier's Viewpoint in Selling Coal."

D. M. Given of the Union Carbide Corporation general purchasing department will discuss the industrial plant's interests pertaining to the purchase of coal.

The related topic "Analysis of Fuel Trends in Utilities" will be covered by Myles E. Robinson of the National Coal Association.

"Combustion Control for Burning Two Solid Fuels" will be the subject of a paper prepared by R. C. Rodenburg of Rust Engineering Company.

"New Concepts—Coal From Mine to Industrial Boiler" will be the topic of a paper by C. E. Day, fuels consultant for the E. I. du Pont de Nemours & Company, Inc.

Another topic on a more concentrated technical level, "Effects of Volatile Matter on Flame Propagation in Pulverized Coal-Fired Units" will be prepared by J. F. Mullen of the Pittston Clinchfield Company. Additional papers will be presented at the three conference sessions relative to the general theme of this year's meeting.

Several plant tours are being arranged for those attending the conference interested in visiting one of several Kanawha Valley enterprises. In addition, a separate program for the women attending the conference is being prepared.

The conference is sponsored jointly by the Fuels Division of The American Society of Mechanical Engineers, and the Coal Division of the Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers.

## ASME Rubber and Plastics Division Annual Conference to Be Held October 9–11

The first annual conference of the ASME Rubber and Plastics Division will be held in Erie, Pa., on October 9-11, at the Hotel Lawrence. Following are the four basic subject classifications: Vibration and shock control; bonding of engineering structures; nonrigid structures; and automation of rubber and plastics processing.

Highlighting these subjects, Warburton Hall, Minister of Aviation, London, England, will present his paper on "Dracone Flexible Barges." A. L. Everitt, Inland Manufacturing Company, Division of General Motors, will cover automotive engine mount design; Walter Bird, Birdair Structures, Inc., Buffalo, N. Y., inflatable buildings; and W. D. Harris, The Dow Chemical Company, mechanical testing.

Registration will begin on Sunday, October 9, at the Hotel Lawrence, followed by an "Early Bird Party" to be held between 5:30 and 7:30 p.m. This event is being sponsored by the Erie Section with the co-operation of Erie Industry and is open to registrants and their guests.

Keynoting the conference will be C. Howard Adams, Chairman of the Division. Mr. Adams is with the Monsanto Chemical Corporation and is well known in industry due to his many years of experience in the field and his work with many technical societies.

The main luncheon speaker, Monday, October 10, will be Dr. Turner Alfrey of Dow Chemical Company's Polymer Research Laboratory, who, in addition to being an outstanding scientist and author, also is well known as a lecturer.

The two plant tours will include the Hammermill Paper Company and the Molded Fiber Glass Corporation. At the latter will be shown molded truck cabs, automobile bodies, and boats.

### Availability of Papers

Please do not order technical papers listed in this program. Copies were not available when this program went to press. Copies will be available at the conference or consult the final listing which will be found in the issue of Mechanical Engineering containing the account of the conference and instructions on how to order available technical papers.

### ▲ MONDAY, OCTOBER 10

**Session 1** **9:00 a.m.**

**Novel Design in Sandwich Structures,** by *A. C. Marshall,* Hexcel Products, New York, N. Y.

**New Apparatus for Study of Mechanical and Electrical Properties of Plastics,** by *S. M. Skinner* and *E. L. Kern,* Case Inst. of Tech., Cleveland, Ohio

**Reinforced Plastic Films as an Engineering Material,** by *Johan Bjorksten,* Bjorksten Research Labs., Madison, Wis.

**Plastic Pipe for Industry and the Home,** by *L L. Loudin, Jr.,* Marbon Chemical Borg-Warner Corp., Washington, W. Va.

**Session 1A** **9:00 a.m.**

**Processing Equipment for Liquid Urethane Elastomers,** by *J. A. Hanzel,* du Pont, Wilmington, Del.

**Presses in the Rubber and Plastics Industry,** by *Everett Perlberg,* Adamson United Co., Hackensack, N. J.

**Automated Tire-Curing Room,** by *L. E. Soderquist,* McNeil Machine & Engineering Co., Akron, Ohio

**A New Viscoelastic Compound for the Suppression of Noise and Vibration in Structures,** by *C. H. Peterson,* Lord Mfg. Co., Erie, Pa.

**Magnetic Rubber, a New and Useful Material,** by *R. J. Webster,* Denman Rubber, Warren, Ohio

**Session 2** **2:00 p.m.**

**Air Structures—a New Concept in Engineering Design,** by *Walter Bird,* Birdair Structures, Buffalo, N. Y.

**Thermoforming—Its Processes and Applications,** by *J. R. Lynch,* Dow Chemical Co., Midland, Mich.

**Adhesion Theory,** by *J. E. Rutzler, Jr.,* Case Inst. of Tech., Cleveland, Ohio

**Stress-Strain Relations in Cross-Linked Polyethylene,** by *I. L. Hopkins,* Bell Telephone Labs., Murray Hill, N. J.

**Inspection Trip—** **2:00 p.m.**
**Hammermill Paper Co.**

### ▶ TUESDAY, OCTOBER 11

**Session 3** **9:00 a.m.**

**The Analog Computer and Its Application in the Rubber and Plastics Industry,** by *Adolph Kats* and *Paul Berthiaume,* Princeton Computation Center, Princeton, N. J.

**An Introduction to Biaxial Stress Problems in Fabric Structures,** by *A. D. Topping,* Goodyear Aircraft, Akron, Ohio

**Fabric Space Structures,** by *J. T. Harris,* Goodyear Aircraft, Akron, Ohio

**Elastomers as a Structural Material,** by *E. E. Thielker,* duPont, Wilmington, Del.

**Engineering Planning and Design Requirements for the Handling of Collapsible Rubber Containers,** by *Neuberne Brown,* OTD Container Corp., Warwick, R. I.

**Session 3A** **9:00 a.m.**

**Design-Strength Data and Calculation for Long-Term Use of Thermoplastics,** by *W. D. Harris,* Dow Chemical Co., Midland, Mich.

**The Resin Stress Distribution of Reinforced Fibers,** by *J. O. Outwater,* Univ. of Vermont, Burlington, Vt.

**Obtaining Stress Per Cent Compression Diagram of Foamed Plastics at High Rates of Compression,** by *R. C. Dove* and *W. E. Baker,* Univ. of New Mexico, Albuquerque, N. Mex., and *C. D. Beaman,* Creole Petrol Co., Maracaibo, Venezuela

**Annual Review of Engineering Developments in Plastics Industry,** by *George Jackson,* Monsanto Chemical Co., Springfield, Mass.

**Session 4** **2:00 p.m.**

**Dracone—Flexible Barges: Some Problems of Design, Materials, and Construction,** by *Warburton Hall,* Ministry of Aviation, London, England

**Elastomers Applied to Structural Damping,** by *Bruce Campbell,* Lord Mfg. Co., Erie, Pa.

**Automotive Engine Mount Design,** *A. L. Everitt,* Inland Mfg. Co., Dayton, Ohio

**Elastomeric Gyro Suspensions,** by *J. W. Gwinn,* Lord Mfg. Co., Erie, Pa.

**Polyester and Hypalon Films to Plywood,** by *Wilkinson,* C. A. Litzler, Cleveland, Ohio

**Inspection Trip—** **2:00 p.m.**
**Molded Fiber Glass**

# ASME Acts to Improve Operating Efficiency; Member Service

Two STEPS to improve the Society's operation—a revised arrangement of geographic regions and a new calendar of administrative and operating years—were announced at the 1960 ASME Summer Annual Meeting. Designed to improve service to members and eliminate unnecessary confusion, both steps will be put into effect during the 1960 ASME Winter Annual Meeting.

## Society Regions Increase From Eight to Ten

Effective on Nov. 28, 1960, ASME's eight Regions will be increased to ten as a result of membership growth in the Midwest and Far West. The move was designed to "improve service to the members and make ASME's geographical organization consistent with today's realities." During the past two decades the Society's membership has more than tripled. This increase has brought about an increase in the number of Sections which in turn has necessitated an expansion of Regional operations in the Society.

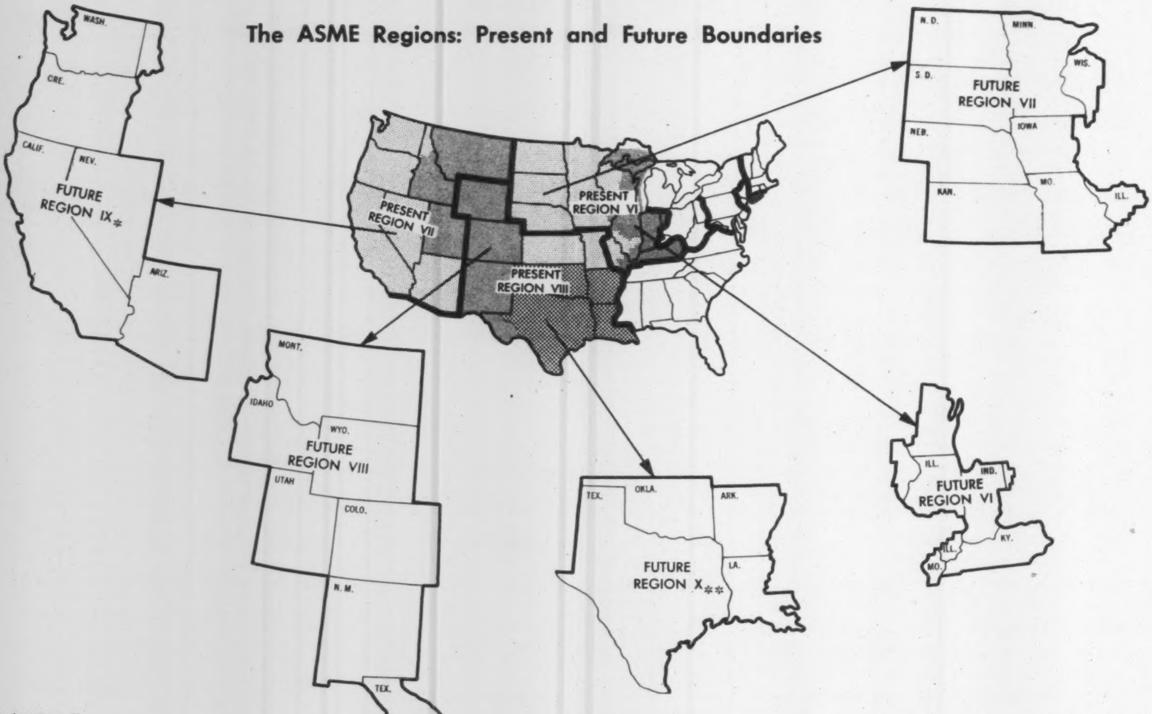
The Vice-Presidents over the past five years have conducted a series of extensive studies of the regional organization of the Society. They considered the original boundaries of the Founder Societies as well as those of other technical groups. Their analysis showed a wide variation in the size of regions or districts. The eight Regions were considered from the standpoint of area in square miles, the number of members and student members to be served, and the number of geographical and Student Sections in each State.

After thorough study it was decided that Regions I through V should not be changed, but that Regions VI, VII, and VIII, because of the greater areas to be served, be divided into five Regions, thereby making a total of ten Regions in the Society. The Vice-Presidents' proposal was then referred to the Organization Committee and the specific regional boundaries as shown on the accompanying map were resolved. In selecting the boundaries existing Section boundaries were not changed.

In order that the proposed realignment of Regions VI, VII, and VIII would have the widest possible discussion, the Vice-Presidents placed an item on the 1959 National Agenda and the proposal was discussed in detail by each of the eight Regional Administrative Committees. The item was unanimously approved and was, therefore, discussed by the Regional Delegates when they met during the 1959 Semi-Annual Meeting held in St. Louis, Mo. The Regional Delegates recommended to the Council that the proposal to realign Regions VI, VII, and VIII be approved. The Council accepted their recommendation and again referred the matter to the Organization Committee for study and comment. The Organization Committee recommended favorable action by the Council. This was done by the Council during the 1959 ASME Annual Meeting in Atlantic City, N. J.

It was agreed that the realignment would take effect at the time of the 1960

New ASME setup—New boundaries become effective Nov. 28, 1960


The ASME Regions: Present and Future Boundaries

*Includes Hawaii
**Includes Mexico

Winter Annual Meeting. To do this, the following steps had to be taken: (1) The charter of the Society was changed with the approval of the membership at the Business Meeting in St. Louis on June 15, 1959. (2) The necessary constitutional amendments were proposed and approved by the membership. This was reported at the Business Meeting in Dallas, Texas, on June 6, 1960. (3) The necessary changes in the By-Laws of the Society were approved by the Council in Dallas on June 5, 1960.

To complete the realignment by December, 1960, two other major actions were necessary: (1) The nomination of Vice-Presidents for the affected Regions. (2) A change in the Regular Nominating Committee to provide for representation from the new Regions. With respect to the change in the Regular Nominating Committee, this could not be effective until the 1961 Regular Nominating Committee was elected at the Business Meeting in Dallas on June 6, 1960. The 1960 Regular Nominating Committee (consisting of 11 Members elected at the Business Meeting in St. Louis on June 15, 1959) selected a full slate of Officers and Directors for 1961. (See page 109, July, 1960, MECHANICAL ENGINEERING.)

In order to provide the 1960 Regular Nominating Committee with the necessary proposals for Vice-Presidents for the affected Regions, two additional Nominating Conferences were held during 1960—one on April 30 at Minneapolis, Minn., during the 1960 Region VI RAC Meeting, and one at Salt Lake City, Utah, on May 7. This provided a means for the new Regions VII and VIII to (1) select a Member and First Alternate for their 1961 Regular Nominating Committee and (2) propose at least two candidates for Vice-President of their respective Regions.

# Regional and Administrative Years Changed

From the time of its organization, the Society operated administratively from Annual Meeting to Annual Meeting (from about December 1 through November 30). When the Vice-Presidents were charged with regional responsibilities, in 1946, the operating year for Regional Committees was organized on a basis to coincide with the terms of office of the Vice-Presidents. That is, the regional year coincided with the Society's administrative year — from Annual Meeting to Annual Meeting. The Sections and Student Sections on the other hand were organized to operate on a year commencing on July 1 and concluding on June 30.

Many disadvantages have resulted from these operating years being out of phase with one another. The Vice-Presidents have been affected in particular because they and their Regional Committees must work closely with Section and Student Section officers. The Vice-Presidents have felt that the effectiveness of this liaison requires that the terms at the two levels should coincide so that good working relationships could be built early and maintained throughout the year.

Several items have appeared on the National Agenda in recent years proposing that something be done to realign these different operating years of the Society. The Vice-Presidents discussed various proposals in detail when they met during the 1959 Semi-Annual Meeting in St. Louis. As a result of this discussion a proposal was made to change the regional and administrative years to parallel more nearly the existing Section year. Because a study of this subject had been made several years ago by the Organization Committee, the proposal was explored by that group. Upon recommendation of the Organization Committee, the Executive Committee of Council referred the matter back to the Vice-Presidents who then requested that such an item be included on the 1960 RAC Agenda. The Item was discussed by each of the eight Regional Administrative Committees and was unanimously approved. The Regional Delegates discussed the Item when they met at Dallas during the 1960 Summer Annual Meeting and made a unanimous recommendation to the Council that such a plan be adopted. Acting on this recommendation the Council made the necessary By-Law changes and after a six-month adjustment period the change will be completed.

Under the changed procedure, the Regional and Administrative years will run from Summer Annual Meeting to Summer Annual Meeting. This means that all personnel serving on the National Boards and Committees will ultimately take office at the close of the Business Meeting during the Summer Annual Meeting. Nominations for appointment to National Boards and Committees will be due on March 1 rather than September 1 as has been the practice in the past.

With respect to the nomination, election, and indoctrination of National Officers and Directors of the Society, the Nominating Conferences held in the spring during the Regional Administrative Committee Meetings and the three Nominating Conferences held by the Technological, Codes and Standards, and Administrative activities will suggest candidates for National Office to the Regular Nominating Committee who will meet as in the past at the Summer Annual Meeting. As a result of their deliberations, a slate of officers will be nominated to fill the forthcoming vacancies. The ballots will be submitted to the membership in August and will be tallied by the official election tellers in late September. After the election, the officers-elect will commence their indoctrination which will consist of a special indoctrination meeting in October and a meeting with the Council during the Winter Annual Meeting. For the Vice-Presidents-Elect, the Regional Student Conferences, the Regional Administrative Committee Meetings, and other Regional activities during April and May will provide valuable experience under the guidance of the incumbent Vice-President. At the Summer Meeting then (one year after being nominated), the officers-elect will commence their terms and meet as the "New Council."

Biographical sketches of the new slate of officers and directors will be found on pages 123–127 of this magazine, and it should be noted that each one's term expires at a Summer Annual Meeting. In view of the six-month adjustment period, no terms will expire during the 1961 Summer Annual Meeting.

## Pamphlet Papers: Prices Increased

RISING editorial, paper, and production costs have forced the Publications Committee to increase prices for pamphlet copies of technical papers. At the same time, the increase will also provide price uniformity with our sister societies with whom we hold a number of Joint Conferences. Effective with meetings and conferences held after July 1, 1960, therefore, prices of pamphlet papers will be increased to $1 to nonmembers; 50 cents to ASME members. Prices for books of ten coupons will be $8 to nonmembers; $4 to ASME members.

# 1960
# REGIONAL ADMINISTRATIVE COMMITTEE MEETINGS

During April and May each of the eight Regions conducted its Regional Administrative Committee Meeting. The main objective of the RAC Meeting is to provide a meeting of minds with the Vice-President on Regional and Society operating problems. The meeting also affords an opportunity to express the views of the Region on the National Agenda as well as to provide a forum for the representatives of Sections to further the nominating procedure for national offices.

The Vice-President of the Region serves as Chairman of the RAC and his Regional Secretary as Secretary. Each Section in the Region sends two representatives, one of whom is usually the current Chairman. In addition to the Section representatives, there are usually present at each RAC meeting the various Regional Committee Chairmen.

Each of the Regional Administrative Committees elects annually a junior delegate to go to the Regional Delegates Conference for two years. The RDC is held in conjunction with the Summer Annual Meeting of the Society—with each Region sending a senior and junior delegate. The principal business of the RDC is to act on the consolidated list of Agenda Items which have received the approval of three or more Regional Administrative Committees.

The present procedures have evolved from long experience with various methods of bringing together representatives of the Sections. Delegates from Sections first met at the 1915 Spring Meeting held in Buffalo, N. Y., with two representatives from each of the then 15 Sections.

As the Society continued to grow, several other procedures were employed. In 1945 the Vice-Presidents were assigned regional responsibilities and the present Regional Administrative Committees and Regional Delegates Conference were formalized.

A report on the 1960 Regional Delegates Conference held during the 1960 Summer Annual Meeting in Dallas will appear in a forthcoming issue of Mechanical Engineering.

**NEW LONDON, CONN.**
**Front Row, left to right,** J. H. Osgood, Mrs. J. H. Osgood, J. M. O'Byrne, D. B. MacDougall, Miss C. Bachand, C. H. Coogan, Mrs. A. Hammer, A. Hammer, Mrs. H. Duchacek, H. Duchacek.
**Middle Row, left to right,** R. W. Boyle, F. Shires, P. W. Meyer, C. G. Parker, S. C. Leland, T. N. Graser, R. B. Dowdell, T. Keel, T. Chanoux, L. J. Brancato, C. C. Bigelow, G. S. White, W. P. Berggren.
**Back Row, left to right,** J. W. Lux, T. C. Warner, Jr., J. E. Kuehn, D. Taylor, J. R. Canal, J. W. Swan, R. J. Tracy, H. W. Carlson, A. F. Green, A. S. Morton, R. Neuendorffer.

## REGION I

**SOUTHAMPTON, L. I., N. Y.**
**Front Row, left to right,** C. Handen, V. W. Smith, G. B. Thom, G. Hahn, R. W. Bryant, W. Cooperman, E. Miller, P. T. Paraskevas, H. Skarbeck, P. Osterman, T. Reinauer, C. Colangelo, W. Moen, M. Bishop.
**Second Row, left to right,** E. Bance, S. Lovejoy, Jr.; C. T. Oergel, W. Budny, B. Meany, W. E. Krutzsch, U. A. Rothermel, D. B. MacDougall, L. H. Schmerzler, R. E. Abbott, J. Campbell, C. R. G. Dougherty, N. Addonizio, W. H. Byrne, J. L. O'Neill, A. M. Perrin, J. Muenger.

## REGION II

**SYRACUSE, N. Y.**
**Front Row, left to right,** H. O. Huss, G. I. Vincent, H. J. Loberg, G. L. Graves, D. E. Marlow, W. L. Cisler, ASME President; O. B. Schier, II, ASME Secretary; M. B. Hogan, W. B. Pegram, R. N. Skalwold, F. J. Heinze, W. E. Hammond.
**Middle Row, left to right,** J. H. Palmer, N. P. August, D. D. Taylor, A. F. Bochenek, K. G. Dorwart, J. H. Hollyday, J. R. Connelly, M. L. Jones, L. W. Ott, J. H. Fernandes, T. Howitt, Jr., W. H. Britt.
**Rear Row, left to right,** J. E. Corr, M. Dykman, S. E. Weidler, M. J. Law, R. S. Sherwood, T. S. Fetter, M. J. Spruitenburg, W. E. Cooper, F. O. Lang, A. D. Roubloff, A. J. Westbrock, W. C. Franklin.

## REGION III

# REGION IV

**COLUMBIA, S. C.**
**Front Row, left to right,** J. B. Jones, F. O'Brien, M. B. Crotts, T. B. Kimball, A. Croll, A. H. Hines, Jr.; J. W. Little, O. B. Schier, II; E. E. Burroughs, A. R. Johnson, Jr.; G. B. Carr, C. E. Trent, L. B. Conner, B. King, J. C. Cook.
**Middle Row, left to right,** K. P. Hanson, L. Brownlee, A. L. Hay, Jr.; G. Brengelman, B. Thompson, T. F. Furling, R. Meadows, Jr.; G. DeHoff, J. J. Barrier, P. A. Easterling, T. W. E. Hankinson, J. C. Campbell, R. E. Rabun, L. E. Learing, S. Acker, R. S. Kriger, J. F. Bailey.
**Back Row, left to right,** E. C. Blackard, H. K. Couch, J. C. Reed, L. C. Tolleson, J. L. Edward, J. N. Macduff, H. P. Reinhart, E. Vandegrift, Jr.; G. Snellgrove, R. L. Girouord, Robert Juer, Carl Dennis, E. C. Taylor, C. E. Thies, C. W. Brown, L. M. Parker, V. C. Summer, R. S. Anderson.

# REGION V

**CINCINNATI, OHIO**
**First Row, left to right,** W. G. Cornell, J. W. Miller, R. Nelsen, O. B. Schier, II; R. L. Hollaway, H. N. Muller, E. W. Allardt, E. Jacobson, W. C. Bissmeyer, G. Shimp, A. D. Hogg.
**Second Row, left to right,** Harris-Lowe, G. Stout, J. E. Davies, H. Peiffer, N. Eckler, R. Bolz, H. Hauth, J. E. Murray, R. D. Harvey, E. G. Rapp, J. A. Brown, Ross Lord, G. Allman.
**Third Row, left to right,** D. Schild, R. J. Flanigan, T. Hendrickson, S. B. Campbell, A. H. Hoffer, D. Craig, C. Jones, C. Tutt, G. E. Pankrantz, J. Miller, J. R. Lowe, Jr., J. Mitchell.
**Fourth Row, left to right,** M. Smith, H. Cather, D. J. Beecher, T. I. Robinson, E. Youngblood, C. Hall, R. Zimmerman, J. H. Kline, A. H. Figg, E. R. Braun, R. R. Hayes, R. F. Iager, H. Fulton.

# REGION VI

**MINNEAPOLIS, MINN.**
**Front Row, left to right,** R. S. Stover, V. E. Swenson, R. L. Schoenberger, H. B. Ratcliff, C. A. Davis, R. T. Mees, T. J. Dolan, O. B. Schier, II; E. W. Jerger, S. P. Kezios, F. P. Vinella, G. B. Germain, K. F. Potter.
**2nd Row, left to right,** A. W. Vonderhaar, C. R. Earle, C. F. Macchietto, J. W. Peterson, M. E. Jansen, R. T. Paluska, F. Seygarth, D. H. Bein, C. E. Evanson, P. L. Bracht, R. W. Juncal.
**3rd Row, left to right,** L. T. Brinson, G. H. Sample, W. H. Weber, T. R. DuBois, R. W. Mills, E. LaCrosse, Jr.; C. D. Greffe, R. G. Henneman, M. A. Wertheimer, R. J. Harker, R. H. Meyers.
**Back Row, left to right,** C. H. Whitmore, E. R. Friesth, J. F. Pfrank, R. G. Batchellor, M. J. Moseley, E P. Larson, P. W. Kelly.

# REGION VII

**LOS ANGELES, CALIF.**
**Front Row, left to right,** F. P. Wahlquist, W. E. Johnson, C. E. Redfern, W. D. Wood, M. Popovich, D. Marinos, M. Guidon, A. J. Dempsey, W. C. Heath, ASME President, W. L. Cisler, R. H. Meleney, A. K. Ingraham, E. E. Day, H. A. Simms, R. F. Walden.
**Middle Row, left to right,** B. T. McMinn, J. W. MacPherson, O. B. Schier, II; P. J. Swanson, R. D. Reese, L. D'Ooge, W. A. Boyd, M. B. Thacker, E. G. Chilton, H. S. Aurand, S. H. Graf, R. Beach, H. B. Lindblom, E. C. Alford, J. M. Simonsen, R. B. Campbell, W. H. Wallace.
**Back Row, left to right,** R. L. Ridgway, E. E. Forslund, J. E. Wolf, D. F. Watson, D. Martin.

# REGION VIII

**MEXICO, D. F.**
**Front Row, left to right, seated:** G. J. Groh, A. A. Rasmussen, R. Benninghoven, E. C. Beason, O. B. Schier, II; N. L. Miller, Harold Grasse, C. H. Shumaker, J. W. McKiernan, B. P. Abbott, F. A. Thomas.
**Middle Row, left to right, standing:** L. Zoller, G. N. Davis, D. C. Smith, R. A. DeCamp, E. K. Gardner, F. A. Slief, P. K. Harris, B. D. Howell, E. A. Lyle, Landry Murphy, J. P. Wilson.
**Back Row, left to right, standing:** J. H. Colby, D. E. Hale, B. G. Barr, C. M. Simmang, L. A. Platt, A. J. Clark, Jr.; H. A. Thurstin, D. E. Cunningham, W. H. Kohler, L. A. Block, H. R. Sharp.

# William Henry Byrne Nominated for 80th ASME President

# ASME Officers Nominated

During the 1960 Summer Annual Meeting of The American Society of Mechanical Engineers in Dallas, Texas, June 5–9, William Henry Byrne, consulting engineer, owner of Byrne Associates, Inc., and Stevens and Wood, Inc., New York, N. Y., was nominated by the National Nominating Committee to be the eightieth President of the Society.

Regional Vice-Presidents named by the Committee to serve on the Council of ASME were: George B. Thom, Region II; Roy C. Robertson, Region IV; Donald J. Bergman, Region VI; Eaton H. Draper, Region VIII; Allen H. Jenson, Region X. Harold Grasse, currently Vice-President, Region VIII, was nominated to serve as Vice-President of the New Region VII.

Directors named by the Committee to serve for a four-year term included the following: James B. Jones of Blacksburg, Va., and Rolland S. Stover of Marshalltown, Iowa.

Members of the Committee making the nominations were: J. C. Reed, Chairman, Region IV; J. W. McKiernan, Secretary, Region VIII; and R. B. Dowdell, representing Region I; W. B. Moen, Region II; W. E. Hammond, Wellsville, N. Y., Region III; J. D. Carr, Region V; T. Randall DuBois, Region VI; E. E. Day, Region VII; E. P. Partridge, *Technical Division;* H. E. Aldrich, *Codes and Standards;* and G. B. Thom, *Administrative.*

Election of ASME Officers will be held by letter ballot of the entire membership, Sept. 27, 1960.

Brief biographical sketches of the nominees for office follow on the succeeding pages.

## William H. Byrne

William Henry Byrne, the 1960 nominee for President of The American Society of Mechanical Engineers, was born in New York City on Aug. 11, 1900. He attended Stevens Institute of Technology and Polytechnic Institute of Brooklyn, graduating from the latter in 1923 with an ME degree.

In 1923 Mr. Byrne entered the employ of the United Electric Light and Power Company of New York, now Consolidated Edison Company, in the Test Department of the Hell Gate Power Plant and was advanced to the position of assistant to the chief engineer of the Sherman Creek Plant in charge of plant operation and maintenance. This affiliation started him in the field of power-plant engineering. He continued to gain experience in industrial and utility power-plant design, operation, and maintenance with such firms as Furnace Engineering Company of New York; Stevens and Wood, Inc., and its many affiliated utilities such as Commonwealth and Southern Corporation; and as superintendent of production with the Cuban affiliate of American Foreign Power Company in Havana. From 1935 to 1936 he represented, as sales engineer, Condenser Service Engineering and Hagan Combustion Corporation. In 1936 he joined the New York State Public Service Commission as principal valuation engineer, a post held until 1944. It was in that year that Mr. Byrne organized, as a sole proprietorship, his own consulting engineering business. In conjunction with his consulting practice he formed his present firm, Byrne Associates, Inc., and in 1946 acquired Stevens and Wood, Incorporated. Both these entities provide design and drafting services, the former principally in the utility, industrial, and institutional fields and the latter in the marine-design and mapping fields. His engineering assignments have included many projects both here and abroad.

In 1949 he was appointed by the Mayor of the City of New York to organize and direct the first Bureau of Smoke Control for the New York City Department of Housing and Building.

Mr. Byrne invented a successful powdered-fuel burner and a method for closely controlling temperature in combustion chambers. He has written many technical articles on valuation and power plants and on engineering and drafting costs. He is associated with several corporations and is a registered professional engineer in 43 states of the United States in addition to holding a National Certificate of Qualification.

He has been an active member of ASME since 1944 and was made a Fellow in 1959. He has served the Society in numerous capacities on the National, Regional, and Section levels, and was Vice-President of Region II for two terms. He was General Chairman of the Greater New York Business Campaign for the new United Engineering Center.

He served on the Agenda Committee for three years and compiled an index of all National Agenda items; he has been on the Council Committee on Staff Personnel since 1957; he was a Regional Delegate and Speaker for RDC; he was on the Nominating Committee in 1953; he is a member of the Sub-Committee on Care of Steam Boilers in Service, and has also served as Election Teller and Alternate on the Nominating Committee.

On the Section level, he has served as Chairman and Treasurer of the Metropolitan Section Executive Committee. He represented the Metropolitan Section on the Joint Professional Engineer Committee for Study of the Education Law and was Chairman of, and representative of, the Metropolitan Section of the New York City Committee on Smoke Abatement which was a joint committee of The American Society of Mechanical Engineers, the American Society of Heating and Ventilating Engineers, and the National Association of Power Engineers.

In addition to ASME, he has held many offices in and is a member of the National Society of Professional Engineers, the Smoke Prevention Society of America, the American District Heating Association, the Society of American Military Engineers, the National Association of Power Engineers, and the Civil Defense Associates. He is a Fellow and past national president of the American Society of Appraisers (formerly the Technical Valuation Society) and is presently vice-president of the Kings County Chapter of the New York State Society of Professional Engineers. He is on the Board of Management of The Engineers' Club and is a Director of the Downtown Lower Manhattan Association.

He is a member of Tau Beta Pi and Pi Tau Sigma. He has received many honors in the engineering profession including a Certificate of Distinction from Polytechnic Institute of Brooklyn, the "Engineer of the Year" award from the Phoenix Chapter of the National Association of Power Engineers, and the Sixth Annual Honor Award of the Kings County Chapter of the New York State Society of Professional Engineers in addition to five Merit Awards bestowed upon him by The American Society of Mechanical Engineers.

In spite of his busy schedule, Mr. Byrne always finds the time for counseling the many young men who call upon him for advice and help. He is an enthusiastic fisherman and a voracious reader.

# Nominated for Vice-President

## George B. Thom

George Boyd Thom, professor and chairman, mechanical-engineering department, Newark College of Engineering, has been nominated to serve as Vice-President of ASME, Region II.

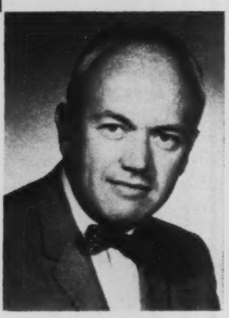
At Lehigh University, where Professor Thom was a student, he was granted three degrees including an ME in 1928; MS, 1932; and MA, 1935. From 1937 through 1939, at The Johns Hopkins University, he continued his graduate study. He is a registered professional engineer in the Commonwealth of Pennsylvania.

Professor Thom's career began as test engineer, 1928–1929, with the General Electric Company. From 1929 to 1935 he was instructor and resident engineer in charge of laboratory installations at Lehigh University. In 1935 he went to Swarthmore College where he was successively assistant professor, associate professor, and chairman of the mechanical-engineering department. Also during this period, 1937–1941, he was engaged part time as an engineer, power-plant design, at the Philadelphia Electric Company. He was employed part time by Sun Shipbuilding and Dry Dock Company from 1940 to 1949. There he was supervisor, engineering defense training; later, director of training; and from 1945 until 1949, assistant director of personnel. In 1949 he was made professor and chairman of the mechanical-engineering department at Newark College of Engineering. Since 1951 he also has been working as part-time engineer in power-plant design at the Philadelphia Electric Company.

**G. B. Thom**

**R. C. Robertson**

**D. J. Bergman**



**E. H. Draper**

He has taken an active part in Society affairs at a national as well as a Section level. He was elected a Junior Member in 1934 and was promoted to Member in 1941. He was National Junior Committee adviser from 1946 to 1952. From 1952 until 1959 he was on the Admissions Committee, serving as chairman in 1957; and adviser in 1958 and 1959. He was RDC alternate for one year. In 1960 he was appointed to the Organization Committee. In Region II he is a member of Department Heads Committee in Mechanical Engineering. His active role at Section level includes his work with the Philadelphia Section, 1936–1949; Northern New Jersey Subsection, 1950–1959; and Metropolitan Section.

He is an active member and holds office in several other professional societies. These are: Middle Atlantic Section, American Society for Engineering Education; Sigma Xi; Engineering and Technical Societies Council of Philadelphia; Technical Societies Council of New Jersey; ECPD and Middle States Association Secondary Schools and Colleges; Pi Tau Sigma; American Management Association; and American Arbitration Association.

Professor Thom also has held a number of civic appointments in Swarthmore and Philadelphia. He is contributing author to Lilly and Aiken, "Teacher Training for Industry," and consulting editor on more than thirteen training manuals.

## Roy C. Robertson

Roy Crawford Robertson, who has been nominated to serve as Vice-President of The American Society of Mechanical Engineers, Region IV, is a design engineer at the Oak Ridge National Laboratory, which is operated by the Union Carbide Nuclear Company for the Atomic Energy Commission.

Mr. Robertson was born in North Carolina in 1916. He was graduated from the University of Tennessee with a BS degree in 1938 and with an MS degree in 1940. After serving a short period as assistant editor of *Southern Power & Industry* in Atlanta, he joined the U. S. Engineer Office in Norfolk, Va., to assist in the design of military installations in that area, particularly at Langley Field. During this period he taught evening courses at the William and Mary Division in Norfolk. He then volunteered for duty in the Naval Reserve, serving as ordnance officer specializing in installation, testing, and repair of computing-type antiaircraft fire-control systems.

He returned to teaching in 1946 at the University of Tennessee in Knoxville. As an associate professor of mechanical engineering his activities were mainly in the fields of mechanical laboratory, refrigeration, and air conditioning, and at the time of leaving the University in 1955, was in charge of the steam-power-plant design courses. During the period 1950–1955 he also engaged in engineering consulting work, primarily for the Oak Ridge National Laboratory.

Mr. Robertson joined the ORNL staff in Oak Ridge, Tenn., as a design engineer in the Reactor Experimental Engineering Division and has been associated with the design of the Homogeneous Reactor Experiments Nos. 1 and 2, design studies of several slurry-type reactors, a Darex pilot-plant design for reprocessing of fuel elements, and is currently engaged in design of a molten-salt-type homogeneous reactor. He has written several papers on the heat-power cycles and refrigeration systems associated with reactor plants.

In addition to his professional activities he has been active in civic affairs, serving as a frequent lecturer for high-school career day programs, as Chairman of the Smoke Abatement Committee of the Knoxville Technical Society, and served for four years on the State of Tennessee Board of Boiler Rules which formulated the first set of regulations used in the State. He is a registered professional engineer.

Mr. Robertson has served the ASME as Secretary and then Chairman of the East Tennessee Section, as a member and Chairman of the Region IV Student Branch Committee, and for two years, 1954, 1955, as Secretary of the National Nominating Committee. He received a 75th Anniversary Medal from the Society in 1955.

## Donald J. Bergman

Donald J. Bergman, who has been nominated to serve as Vice-President of The American Society of Mechanical Engineers, Region VI, is at present an engineering consultant to Universal Oil Products Company at Des Plaines, Ill. He was born Nov. 3, 1895, at Wells, Mich.

He attended high school in Wausaukee, Wis., and was graduated from the University of California in 1915 with a BS degree in Electrical Engineering. This was followed by teaching and graduate work at Santa Clara (Calif.) University where he received his PhD degree in Electrical Engineering in 1917.

He worked for the next three years with Schaw Batcher & Company of South San Francisco on the construction of a shipyard, taught at Santa Clara University, and also worked for C. F. Braun & Company in San Francisco. In 1920 he joined Universal Oil Products Company as an engineer in its San Francisco office, then going to Chicago in 1921. In 1935 Dr. Bergman became chief engineer, holding this position until 1958 when he assumed his present position.

Last June he celebrated his 40th anniversary with the company, a period embracing nearly all of its corporate existence.

In the past 25 years Dr. Bergman has been active in the development of refinery-processing equipment, especially thermal cracking, dehydrogenation, polymerization, catalytic cracking, and catalytic reforming process units. He holds 14 patents in his field. He also has presented numerous papers on many phases of petroleum refining before such organizations as The American Society of Mechanical Engineers, American Chemical Society, American Institute of Chemical Engineers, Instrument Society of America, and others, as well as various trade associations.

In 1951 Dr. Bergman was made an honorary member of Pi Tau Sigma by the mechanical-engineering department of Northwestern University, Evanston, Ill. In 1957 he received the Award of Merit from the Chicago Technical Societies Council for outstanding service to the technical community of Metropolitan Chicago.

He joined The American Society of Mechanical Engineers as a Junior Member in 1924 and was promoted to Member grade in 1935. His major activity has been in its Instruments and Regulators Division. In 1954 he was elected to the Executive Committee of that Division and was its chairman for 1957–1958. In 1957 he also was general chairman of the IRD meeting at Northwestern University. As chairman of IRD's Executive Committee he initiated efforts to co-ordinate the many meetings on instrumentation into meetings of more centralized character, work which has culminated in a five-society joint meeting which will be held in September, 1960.

In 1947 his work in the Instruments and Regulators Division was recognized by the Chicago Section of ASME, which elected him vice-chairman. He became chairman of the Section for 1950–1951. During his affiliation with ASME he has served on numerous Section committees.

Dr. Bergman's activities in related society groups include service on Subcommittee No. 3 on Petroleum Refinery Piping and on Committee on Mechanical Design of ASA Sectional Committee B31 on Code for Pressure Piping. He collaborated with other authors in writing a section for the *Metals Handbook*, published by the American Society for Metals; similarly, he wrote a heat-transfer section for the American Society of Heating and Ventilating Engineers Handbook. As a member of the speakers group of the Chicago Section of American Chemical Society, he has made many vocational-guidance talks at high schools in the Chicago area. He also has been active as a member and board chairman of Future Engineers of America, a group organized to promote activity in mathematical contests by high-school students in the U. S. He formerly was a vice-president of the Chicago Technical Societies Council.

For many years he was active in the Boy Scouts of America, among his other activities serving for ten years as its Commissioner for Kenilworth, Ill. His principal hobby has been sailing. He won the national canoe sailing championship in 1929, and has competed in district and international sailing events in his Star Class boat. He is a member of Westmoreland Country Club, Sheridan Shore Yacht Club, California Alpine Club, and American Canoe Association.

Dr. Bergman is a registered professional engineer in the State of Illinois and holds memberships in American Chemical Society, Instrument Society of America, American Petroleum Institute, and Western Society of Engineers.

## E. H. Draper

Eaton Hamilton Draper, who has been nominated to serve as Vice-President of The American Society of Mechanical Engineers, Region VIII, was born June 18, 1918, in Denver, Colo., where he attended school and was graduated in mechanical engineering by the University of Colorado in 1940. He did some graduate work at Stevens Institute, Hoboken, N. J.

Mr. Draper joined the Wright Aeronautical Corporation, Paterson, N. J., after graduation, working on design and development of aircraft engines, becoming assistant project engineer on reduction-gear development. After a short interlude with the American Brake Shoe Company, Mahwah, N. J., he joined Los Alamos Scientific Laboratory's Sandia Branch in 1948 to work on atomic weapon ordnance. He left this effort (now Sandia Corporation) in 1955 for one year to serve as engineering manager of the newly formed Avco Research and Advanced Development Division on reentry vehicle development. He was made director of systems development at Sandia Corporation in 1957.

Mr. Draper's ASME activities have centered in the New Mexico Section of which he has been a member since 1952, and which he served as Program Chairman one year, and Director of the Section from 1957 to 1959. He is presently a director of the Albuquerque Chapter of the American Ordnance Association. Also he belongs to Pi Tau Sigma Honorary Fraternity and Phi Delta Theta Fraternity and participates in Albuquerque Boy Scout activities.

## Allen H. Jensen

Allen Harold Jensen, who was nominated to serve as Vice-President, Region X of The American Society of Mechanical Engineers, was born Dec. 13, 1915, in Brooklyn, N. Y. In 1937 he was graduated from the Georgia Institute of Technology with a BSME degree. His honors include membership in Tau Beta Pi, Pi Tau Sigma, Omicron Delta Kappa, and Phi Kappa Phi. He is presently mechanical engineer in charge of maintenance, New Orleans Public Service, Inc.; and is a registered professional engineer in the States of Illinois and Louisiana. During World War II he was Commander in the U. S. Navy—ASW and Salvage.

Mr. Jensen was elected a Member of ASME in 1946 and has served the Society almost continuously since then. In the New Orleans Section he has been chairman of the Program Committee as well as secretary-treasurer, vice-chairman, and chairman of the Executive Committee.

Also he has been vice-chairman of the Local Arrangement Committee for the Petroleum Conference in 1955 and the Oil and Gas Power Conference, 1956. On the National level he was RDC Speaker in 1955; chairman, Agenda Committee, 1958; and chairman, Nominating Committee, 1959. In regional activities he also has held many offices.

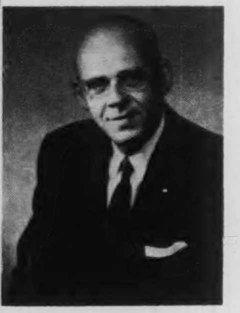
He also is a member of the Louisiana Engineering Society and takes an active part in the Gentilly Rotary and Boy Scouts.

## Harold Grasse

Harold Grasse, nominee for Vice-President of The American Society of Mechanical Engineers, new Region VII, for one year, was born in Spartanburg, S.C., Oct. 31, 1911. In 1917, his family moved to Kansas City, Mo., where he was educated in the public schools. He was graduated from the University of Kansas in 1936 with a BS degree in mechanical engineering. While at college he was active in the ASME Student Section and, in 1935, won second place in the student-paper competition at the Northern Tier Student Conference.

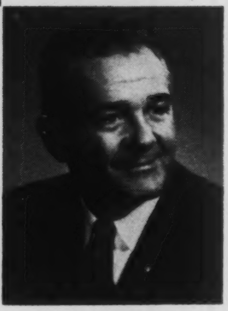
Following graduation, he worked as a manufacturers' agent until he became

**A. H. Jensen**



**Harold Grasse**

**J. B. Jones**



**R. S. Stover**

affiliated with Black & Veatch in 1938 where he was concerned chiefly with steam central station design. From 1938 to 1944 he worked on specifications, estimates, equipment selection, and piping design. Then he was in charge of mechanical drafting and the piping-design section. He advanced successively to project engineer and, in 1956, he was made a partner and principal engineer. He resigned from the firm in June of this year.

As a result of an interesting design problem, Mr. Grasse presented a paper, "A Solution to Inadequate River Cooling Water Supply," at the 1953 Annual Meeting of Region VIII, in New Orleans. "A Comprehensive Training Program for Power-Plant Personnel" was written after conducting a five-month seminar instructing and training shift supervisors and operators in the design features and operating procedures of a new central station on which he was project engineer. This paper was presented at the Semi-Annual Meeting of the Society in Boston, in 1955.

He published his address to the Student Sections in Region VIII entitled "Values" and distributed copies throughout the Region.

During World War II he was commissioned a Lieutenant in the U. S. Naval Reserve and specialized in ship-salvage operations and deep-sea diving.

Mr. Grasse joined ASME in 1937 and from 1940 to 1952 served on the Executive Committee of the Kansas City Section, as chairman during last year. He was a member of the Local Affairs Committee in 1952 for the Petroleum Division Conference and local chairman in 1954 for the Oil and Gas Power Division Conference.

From 1950 to 1952, he was a member of the Regional Student Section Committee and its chairman in 1953. He was a Delegate to the Regional Administrative Committee from 1950 to 1953. For the next five years he served as Secretary of Region VIII. He was elected Vice-President of Region VIII in 1958 to serve a two-year term.

He initiated the Kansas City Industrial Forum Program as a service to student mechanical engineers and has been a judge of the Science Fair for several years.

He is a member of the Missouri Society of Professional Engineers, NSPE, and the Engineers' Club of Kansas City. He is a registered professional engineer in the State of Missouri.

In his community of Leawood, a suburb of Kansas City, he has been City Street Commissioner for two years and was a member of the Commission on Highway Planning in Johnson County, Kan.

# Nominated for Director

## J. B. Jones

James Bernard Jones, who has been nominated to serve as a Director of The American Society of Mechanical Engineers, was born in Pendleton, Va., July 11, 1900. He was graduated from the Virginia Polytechnic Institute in 1921 with a BS degree in mechanical engineering. He received the ME degree from the same institution in 1922, the MS degree from Iowa State College in September, 1924, and the MME degree from Cornell University in 1929.

Before his graduation from college, he was employed as a machinist helper in the locomotive shops of the C.&O. Railway Company. After graduation he spent two summers employed by the Engineering Experiment Station, Iowa State College.

He was a Fellow in the department of applied mechanics and experimental engineering at the Virginia Polytechnic Institute for the session 1921–1922. He was appointed instructor in the same department during the summer of 1922 and continued to serve in that department until June, 1932, having attained the rank of associate professor. In June, 1932, he was transferred to mechanical engineering as head of the department, a position he still holds, and 1937 he was promoted to the rank of full professor.

Professor Jones became a Junior Member of the Society in 1923, a Member in 1935, and Fellow in 1958. He has served as chairman of the Virginia Section, as honorary chairman of the Virginia Polytechnic Institute Student Branch, and was chairman of the Student Branch Committee for Region IV. He served as chairman of the Local Sections Conference in 1941 and was secretary of the National Delegates Conference in 1942; member of National Nominating Committee in 1945 and 1947, chairman in 1947; secretary, Region IV, from 1950 to 1954, Vice-President, Region IV, 1954–1956; Chairman, Mechanical Engineering Department Heads, Region IV, 1958–1961; and member of National Committee of Mechanical Engineering Department Heads, 1958–1961. He was presented the 75th anniversary medal by the Virginia Section in 1955.

Professor Jones is a member of Tau Beta Pi, Pi Tau Sigma, Omicron Delta Kappa, Sigma Delta Psi, Alpha Phi Omega, Sigma Mu Sigma, honorary fraternities. He is also a member of the American Society for Engineering Education, Southwestern Virginia Engineers' Club, The Virginia Educational Association, and is past-president of the Blacksburg Lions Club. He is a registered professional engineer in the Commonwealth of Virginia.

# Rolland S. Stover

Rolland S. Stover, who has been nominated to serve as a Director of The American Society of Mechanical Engineers, is owner of the R. S. Stover Company of Marshalltown, Iowa. He also is secretary-treasurer of the Iowa Pipe & Supply Company, Cedar Rapids, Iowa; and treasurer, Contractors, Inc., of Marshalltown.

Mr. Stover was born in Blairstown, Mo., Aug. 31, 1909, and after receiving his preliminary education at Lawrence, Kan., earned his BS degree in mining engineering at the University of Kansas in 1933.

The summer between his sophomore and junior years he worked for the Wright-Hargraves Goldmines, Ltd., Kirkland Lake, Ont., Canada. The following summer he and some fellow students with a college professor tried prospecting for gold in Idaho's Clearwater National Forest Reserve—again all he earned on the venture was experience.

Directly after graduation he left on a prospecting expedition to the Lincoln National Forest in Lincoln County, N. Mex., but soon returned to accept a job with the Gypsy Oil Company at the Seminole, Okla., field.

Since then, Mr. Stover has participated in some telling pioneering steps in oil production. At Seminole he was assigned to the first acidizing truck, the first use of acid to increase oil-well production, and when he transferred to the drilling department at Hobbs, N. Mex., he participated in the industry's first use of a portable drilling rig powered by natural-gas engines instead of steam for deep production (4000 ft).

Later when he transferred his interest to the sales side of the industry, he joined the Smith Separator Corporation and while with that firm saw the first well drilled for the Rodessa, La., oil boom.

From 1939 to 1943 he was associated with the Fisher Governor Company of Marshalltown. Then he organized his company which he has operated in Marshalltown since that date. The company serves as manufacturers' representative for several of the nation's leading producers of equipment for power generation, heating, and air conditioning.

One of his hobbies—flying—has resulted in his election as president of St. Cloud Flying Service, St. Cloud, Minn.

He has been a member of the Society since 1948. In the Central Iowa Section he has held all offices from secretary to and through chairman, having been chairman in 1951–1952. He was also chairman of the National Nominating Committee in 1954–1955. As Vice-President, Region VI, he was a member of the Council, 1956–1958; and presently is ASME representative to EJC.

Mr. Stover has taken an active role in the affairs of his community as well as in other professional societies; for example, he is a member and past-president of the Rotary Club of Marshalltown, of the Elks, Moose, Phi Mu Alpha, the Chamber of Commerce (past-president), Heating and Ventilating Engineers, Marshalltown Engineers Club (past-president), City Councilman in Marshalltown, and past-president of the Iowa Engineering Society.

In the American Society of Heating and Ventilating Engineers, Iowa chapter, he also has held all offices, having been president in 1950–1951 and chairman of the national chapter Conference Committee in 1955.

He has taken a keen interest in the work of the Iowa Engineering Society since he became a member in 1948. He won the Anson Marston Award in 1951, was treasurer in 1953–1954; president-elect, 1954-1955; and president in 1955–1956.

# ASME 1961 Nominating Committee Organizes

Elected at the 1960 Summer Annual Meeting of The American Society of Mechanical Engineers, Dallas, Texas, June 6, 1960, the 1961 National Nominating Committee at its organization meeting chose Wallace E. Belcher, Jr., as chairman and James R. Muenger as secretary.

The 1961 National Nominating Committee is composed of the following:

**REGION I.** *Representative*, Charles E. Parker, NEGEA Service Corp., Div. of New England Gas and Electric Assoc., 727 Massachusetts Ave., Cambridge 39, Mass.; *1st Alternate*, Frank Shires, asst. to chief engineer, Terry Steam Turbine Co., Terry Sq., Hartford 1, Conn.; *2nd Alternate*, Henry M. Rogers, Jr., Groton Plant, Charles Pfizer & Co., Inc., Eastern Point Road, Groton, Conn.

**REGION II.** *Representative*, James R. Muenger, Beacon Research Lab, Texaco, Inc., Beacon, N. Y.; *1st Alternate*, Gordon R. Hahn, asst. chief mech. engr., Gibbs & Hill, Inc., 461 Eighth Ave., New York 1, N. Y.; *2nd Alternate*, Herman H. Johnson, Mech. Plant Div., Consolidated Edison Co. of New York, 4 Irving Place, New York 3, N. Y.

**REGION III.** *Representative*, Wallace E. Belcher, Jr., Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.; *1st Alternate*, Mervin B. Hogan, supervisor, Reliability Engineering Unit, Heavy Military Electronics Dept., General Electric Co., Room 40, Bldg. 5, Court St., Syracuse, N. Y.; *2nd Alternate*, John W. Sawyer, head, Gas Turbine Engrg., U. S. Navy Code 645, Bureau of Ships, Washington 25, D. C.

**REGION IV.** *Representative*, Erskine Vandegrift, Jr., American Cast Iron Pipe Co., Box 2603, Birmingham, Ala.; *1st Alternate*, T. C. Heyward, Jr., vice-pres., T. C. Heyward & Co., P. O. Box 3066, 518 East Morehead St., Charlotte 3, N. C.; *2nd Alternate*, Carl S. Dennis, field service engr., Coal Traffic Engrg. Div., The Chesapeake & Ohio Railroad Co., 601 First National Bank Bldg., Richmond 19, Va.

**REGION V.** *Representative*, Raymond L. Hollaway, Jr., Anchor Hocking Glass Corp., Res. and Dev. Lab, Plant 35, Lancaster, Ohio; *1st Alternate*, J. Bruce Adams, sales representative, Blackwood-Hodge Equipment Ltd., 10 Suntract Road, Toronto 15, Ont., Can.; *2nd Alternate*, Daniel Schild, asst. for requirements, U. S. Air Force, Directorate of Engineering Standards, Wright Air Dev. Center, Wright-Patterson AFB; for mail, 3220 Cornell Dr., Dayton 6, Ohio.

**REGION VI (New).** *Representative*, Edward W. Jerger, mech. engrg. dept., Univ. of Notre Dame, Notre Dame, Ind.; *1st Alternate*, George V. Miniberger, Harnischfeger Corp., 4400 W. National Ave., Milwaukee 14, Wis.; *2nd Alternate*, Richard G. Henneman, Iowa-Illinois Gas & Electric Co., Davenport, Iowa; for mail, 3223—37th Ave., Rock Island, Ill.

**REGION VII (New).** *Representative*, Dean B. Chenoweth, vice-pres., Mfg and Res. Div., Waco-Porter Corp., 3565 Wooddale Ave., Minneapolis 16, Minn.; *1st Alternate*, Conway B. Briscoe, Water Commissioner, Water Div., City of St. Louis, Room 312, City Hall, St. Louis 3, Mo.; *2nd Alternate*, Robert A. Russell, project engr., Black & Veatch, P. O. Box 8405, Kansas City 14, Mo.

**REGION VIII (New).** *Representative*, Richard B. Stewart, mech. engrg. dept., Univ. of Colorado, Box 785, Boulder, Colo.; *1st Alternate*, Milton B. Thacker, maint. co-ordinator, Utah Oil Refining

## ASME-ASLE Lubrication Conference Announced

The seventh annual Lubrication Conference jointly sponsored by The American Society of Mechanical Engineers and the American Society of Lubrication Engineers will be held at the Statler Hilton Hotel in Boston, Mass., on October 17 through 19.

This conference is aimed primarily at those concerned with research and development in the fields of bearings, gears, seals, and the lubrication thereof. It has become a leading source of information for those actively working in these fields and for others who need to learn what is happening at the forefront of the art and science of lubrication.

Papers now being processed or in preparation include many on components, designs, and materials for, and operation at extreme temperatures, from lubrication with cryogenic fluids to bearings for 1200 F or higher. Interest and activity in gas-bearing development is evidenced by an especially large number of submitted papers. Fundamentals of friction and wear receive considerable attention.

Final details of the program and associated information will be available in a forthcoming issue of Mechanical Engineering.

Co., P. O. Box 898, Salt Lake City, Utah.; *2nd Alternate*, George J. Black, Westinghouse Electric Corp., P. O. Box 376, Idaho Falls, Idaho.

**REGION IX (New).** *Representative*, John W. MacPherson, sales engr., C. C. Moore & Co., 1111 Wilshire Blvd., Los Angeles 17, Calif.; *1st Alternate*, Russell D. Reese, Ted Nelson Co., Swan Island, Portland 17, Ore.; *2nd Alternate*, Arthur K. Ingraham, Public Works Dept., U. S. Navy, U. S. Naval Station, Treasure Island, San Francisco 30, Calif.

**REGION X (New).** *Representative*, Robert G. Critz, product design engr., Bethlehem Supply Co., Box 2171, Tulsa 2, Okla.; *1st Alternate*, James M. Zilboorg, Head of Power Sales, Cia Impulsora de Empresas, Electricas, S. A., Apartado 8-bis, Bolivar 21, Mexico 1, D. F. Mexico; *2nd Alternate*, Kenneth M. Wilson, appl. & field service engr., A. M. Lockett & Company, Ltd., P. O. Box 5126, Beaumont, Texas.

**Technological Division.** *Representative*, Nicholas J. Hoff, Dept. of Aero Engrg., Stanford Univ., Stanford, Calif.; *1st Alternate*, John H. Hitchcock, ch. mech. engr., Morgan Construction Co., 15 Belmont St., Worcester 5, Mass.

**Codes and Standards.** *Representative*, Zenas R. Bliss, Provost, prof. engrg., Engrg. & Admin. Div., Brown Univ., Providence 12, R. I.; *1st Alternate*, Philip Freneau, chief project engr., Southwestern Engrg. Co., 4800 Santa Fe Ave., Los Angeles 58, Calif.; *2nd Alternate*, J. H. Harlow, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa.

**Administrative.** *Representative*, Frank K. Mitchell, P. O. Box 123, Fayetteville, N. Y.; *1st Alternate*, Frank L. Schwartz, professor, dept. of mech. engrg., Univ. of Michigan, 226 W. Engrg. Bldg., Ann Arbor, Mich.; *2nd Alternate*, George F. Habach, vice-pres., Harrison Works, Worthington Corp., Harrison, N. J.

## ASME COMING EVENTS

**August 15-17**

ASME-AIChE Heat Transfer Conference and Exhibit, Statler Hilton Hotel, Buffalo, N. Y.

**September 7-9**

ASME, AIChE, AIEE, IRE, ISA Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass.

**September 15-16**

ASME-AIEE Engineering Management Conference, Morrison Hotel, Chicago, Ill.

**September 18-21**

ASME Petroleum Mechanical Engineering Conference, Jung Hotel, New Orleans, La.

**September 21-23**

ASME-AIEE Power Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.

**October 9-12**

ASME Rubber and Plastic Conference, Lawrence Hotel, Erie, Pa.

**October 17-19**

ASME-ASLE Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

**October 24-25**

ASME-AIME Fuels Conference, Daniel Boone Hotel, Charleston, W. Va.

**November 27-December 2**

**ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.**

**March 5-9, 1961**

ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

**March 12-16, 1961**

ASME Aviation Conference, Statler Hilton Hotel, Los Angeles, Calif.

**March 16-17, 1961**

ASME Textile Engineering Conference, Clemson College, Clemson, S. C.

**April 6-7, 1961**

ASME-SAM Management Engineering Conference, Statler Hilton Hotel, New York, N. Y.

**April 9-13, 1961**

ASME Oil and Gas Power Conference and Exhibit, Jung Hotel, New Orleans, La.

**April 10-11, 1961**

ASME Maintenance and Plant Engineering Conference, Bancroft Hotel, Worcester, Mass.

**April 23-26, 1961**

ASME Metals Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

**May 7-10, 1961**

ASME-EIC Hydraulic Conference, Queen Elizabeth Hotel, Montreal, Que., Canada

**May 10-12, 1961**

ASME Production Engineering Conference, Royal York Hotel, Toronto, Ont., Canada

**May 22-25, 1961**

ASME Design Engineering Conference and Exhibit, Cobo Hall, Detroit, Mich.

**June 11-15, 1961**

**ASME Summer Annual Meeting Statler Hilton Hotel, Los Angeles, Calif.**

**June 14-16, 1961**

ASME Applied Mechanics Conference, Illinois Institute of Technology, Chicago, Ill.

**September 14-15, 1961**

ASME-AIEE Engineering Management Conference, Hotel Roosevelt, New York, N. Y.

**September 24-27, 1961**

ASME Petroleum Mechanical Engineering Conference, Muehlebach Hotel, Kansas City, Mo.

**October 4-6, 1961**

ASME Process Industries Conference, Shamrock Hilton Hotel, Houston, Texas

**October 17-19, 1961**

ASME-ASLE Lubrication Conference, Morrison Hotel, Chicago, Ill.

**November 26-December 1, 1961**

**ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.**

(*For Meetings of Other Societies see page 105.*)

*Note:* Persons wishing to prepare a paper for presentation at ASME National meetings or Division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price to nonmembers, 50 cents; to ASME members, free.

# ASME Power Show to Feature New Trends in Economy

New trends in industrial economy will be featured at the forthcoming 24th National Exposition of Power and Mechanical Engineering, which is designed to advance the latest concepts in the generation of power and applications of energy through power and heat to industries of every description. The biennial Exposition will be held November 28 to December 2 at the New York Coliseum.

**News in Exhibitions.** Already scheduled for exhibition at this year's Power Show are such displays as a model of the nation's newest design and largest atomic power plant. This is to be a 360,000-kw closed-cycle water reactor, projected by a large utility company on the Pacific coast and already well along in the planning stage.

Another line of advanced development will be dieselized electric generators, compressors, and similar independent units such as are used increasingly in construction and other field operations. These units are also finding new uses as standbys, boosters, and on special operations in manufacturing plants.

**Who Will Be There.** In attendance at the 24th biennial display will be technical personnel representing all branches of engineering, from project planning and mechanical design to plant supervision, construction, and operation. Exhibits will be staffed by trained personnel and consultations and exchanges of information with visitors will create a stimulating atmosphere. Admission will be by invitation and registration only. The Exposition will be closed to the public. Members of The American Society of Mechanical Engineers will comprise a large segment of the visitors. The ASME is sponsoring the Exposition in conjunction with its annual meeting in New York and is officially represented on the advisory committee.

**Advisory Committee.** Announcement has been made that Joseph Pope will again be chairman of the advisory committee, whose membership follows: Members at large: F. L. Bradley, consultant, Stone & Webster Engineering Corp.; Chester R. Earle, Editor, *Power Engineering;* M. J. Goglia, dean, School of Mechanical Engineering, Georgia Institute of Technology; Kilshaw M. Irwin, vice-president in charge of engineering, Philadelphia Electric Company; C. E. Morrow, assistant superintendent, construction, Western Electric Company; George A. Orrok, Boston Edison Company; L. N. Rowley, Publisher, *Power;* J. F. Downie Smith, vice-president Research and Development, Carrier Corporation; and A. Bowman Snavely, chief engineer, Hershey Chocolate Corp.

Members representing the ASME: ASME President Walker L. Cisler, President, Detroit Edison Company; R. B. Smith, vice-president, The M. W. Kellogg Company; E. W. Jacobson, chief design engineer, Gulf Research & Development Company; R. G. Folsom, president, Rensselaer Polytechnic Institute; E. M. Barber, supervisor, Special Engine Research Department, Texaco Research Center; Kerr Atkinson, consulting engineer; W. B. Wilkins, Reinforced Plastics, Inc.; and Secretary O. B. Schier, II.

## Call for Agenda Items for 1961 RAC Meetings

The 1961 Agenda Committee extends an invitation to every member of ASME to offer suggestions and improvements in the operations of the Society. This invitation is a step in the democratic process by which the membership and the Sections impart their ideas to the Council.

Please word your proposed items so that they are clear and specific and so that there will be no misunderstanding as to intent. Also, be sure the wording is positive so that action can be taken either to "accept" or "reject" the item as worded. Accompany each item with a short statement as to why you feel the item should be approved.

All agenda items are to be submitted in accordance with the following form, *and should be sent to the Secretary of your Section not later than Oct. 1, 1960.*

The Agenda Committee of each Section will screen these items against items previously considered by the Council, and forward the items to the National Agenda Committee not later than Nov. 1, 1960.

If you lack the address of your Section Secretary, you may send your items, *not later than October 1, to the ASME Agenda Committee, 29 West 39th Street, New York 18, N. Y.*

**ASME Agenda Item**

Proposed by........................of the......................Section

Address..........................................................................

Date.......................... ....................................

Signature

Item: It is proposed that.....

Proposer's Comment:

# ASME Elects Eight to Grade of Fellow

The American Society of Mechanical Engineers has honored eight of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a Member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or Members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

### F. L. Schwartz

Frank LeRoy Schwartz, professor of mechanical engineering at the University of Michigan, has been continuously and effectively employed since 1930 in various ranks of engineering teaching with special emphasis in the fields of thermodynamics, internal-combustion engines,

Dr. Jesse W. Huckert, **left**, receives certificate of Fellow ASME from Robert L. Hahn, chairman of the Production Engineering Division, at the Productivity Luncheon held during the National Engineering Conference, Schroeder Hotel, Milwaukee, Wis. (See biographical sketch in MECHANICAL ENGINEERING, July, 1960, page 112.)

and gas turbines. He has taught at the University of Pittsburgh and Pratt Institute.

Outside of classrooms, he has been engaged in consulting activity for electrical, heating, and copper companies as well as for the Bureau of Ships since 1948; for the Detroit Arsenal since 1952; and for the Continental Aviation and Engineering Company since 1944.

In the field of writing he has authored or coauthored four books and numerous technical papers on such subjects as gas turbines, automotive nuclear heat engines, nuclear heat-power plants, dynamics, and thermodynamics. In addition, he has written ten University of Michigan Research Institute Reports. As a member of ASME he has been chairman of the Gas Turbine Power Division, Executive, Education, and Awards Committees; he has served on the Constitution and By-Laws Committee and the Organization Committee. He has been on the Heat Transfer Division Papers Review Committee. He is a past-chairman of the Detroit section of ASME.

His organizational activity has included assignments in the following and other groups: ASEE, SAE, Pi Tau Sigma, in which he was elected president, Sigma Xi, National Society of Professional Engineers, and the American Association of University Professors.

Recently he was named contributing editor of *Gas Turbines*, a new magazine. He has a professional engineer's license for the State of Michigan.

## K. L. Selby

Kenneth Leonard Selby, vice-president and general manager, Transportation Products Division, National Malleable and Steel Castings Company, Cleveland, Ohio, is responsible for activities of sales operations of two plants and is in charge of the company Technical Center.

Several designs of freight-car trucks were de signed and placed in service, a new line of rubber-cushioned draft gears were developed and put into use while Mr. Selby was in charge of the Railway Department's engineering division. As chairman of the Mechanical Committee of the Standard Coupler Manufacturers, the continued development of the AAR Standard Couplers and attachments was managed, correlating the talents of four competitive manufacturers. As chief engineer of the Technical Center, Mr. Selby has been in charge of approximately 200 current engineering projects. An expanding international division required his visits to Europe, South America, Mexico, and Canada resulting in development of a special connector coupler capable of connecting steam and air lines as well as electrical circuits and a design of draft gear and freight car truck adaptable to foreign production and application. During the period 1953–1958 two designs of alignment control couplers capable of resisting the high misalignment forces encountered with multiple-unit diesel operation were developed and the present line of "400" series draft gears were designed, tested by the AAR, and approved for application to freight cars in interchange service.

Self-contained feature and improved rubber pad contour were ideas originated during administration of this development program. Mr. Selby fostered the conception of vertical automatic operation of couplers in the container handling field. He has been a member of ASME since 1946; and is a member of SAE, SESA, and CES, and author of papers on couplers.

## M. E. Merchant

Mylon Eugene Merchant, director of physical research, The Cincinnati Milling Machine Company, Cincinnati, Ohio, has earned a highly regarded international reputation as a leader in the fields of friction, lubrication, and metal cutting. In 1938 he established a simple relationship governing the laws of static friction that harmonized two major opposing views of the mechanism of friction which had existed since 1785. In the field of lubrication, Dr. Merchant is recognized as an authority on boundary lubrication, cutting fluids, and cutting-fluid action. In the field of metal cutting, his original concept of the basic mechanics of the metal-cutting process may be considered the cornerstone upon which has been built the presently accepted theory of metal cutting. He received the 1959 ASME Richards Memorial Award for the afore-mentioned contributions. He was recipient of the 1959 ASLE National Award for his outstanding contributions in the field of lubrication. The Technical and Scientific Societies Council of Cincinnati presented him with their "Engineer of the Year" award in 1955. He is a Titular Member of the International Institution for Production Engineering Research and a member of ASTME, ASLE, ASM, APS, AAAS, SESA. Honorary fraternities include Phi Beta Kappa, Tau Beta Pi, and Sigma Xi. He has published numerous papers in the fields in which he specializes. He is a registered professional engineer in the State of Ohio.

## R. C. Allen

Robert Chester Allen, director of mechanical engineering, Industries Group, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has had 50 years of broad experience in the fields of steam-turbine design, construction, sales, operation, and management. His career began in 1910 when he worked for the Terry Steam Turbine Company, Hartford, Conn., as draftsman and later as assistant engineer. From 1915 to 1931 he served in various capacities with Westinghouse Electric Corporation, E. Pittsburgh and Lester, Pa. During this time he was responsible for the development and standardization of the basic methods employed in steam-turbine design with respect to thermodynamic and fluid-flow procedures and mechanical-stress calculations. From 1926 to 1931 he was in charge of development of new steam-turbine designs and the associated application engineering. The period 1931–1934 included the organization of engineering and research activities and management of special products engineering of the A. O. Smith Corporation, Milwaukee, Wis. Since he joined Allis-Chalmers in 1936 he has been in charge of the development of improved methods for the calculation and performance of steam-turbine elements. He directed many World War II projects there. In addition to steam turbines for electric-power generation of various sizes up to 150,000-kw capacity, the scope of his work included supervision of the building of more than 4 million hp in marine-propulsion turbines. In 1941, he was appointed as an original member of the Special Committee on Jet Propulsion of the National Advisory Committee for Aeronautics. He was in charge of the early work of the company in the jet propulsion field. As a member of a U. S. Navy Mission to England in 1943 he studied British jet-propulsion developments. He directed contract and engineering activities of Allis-Chalmers in the building of the $24 million supercharger production plant and the manufacture of more than 100,000 General Electric B2 turbosuperchargers for bombers and pursuit planes. He has been closely associated with the company's nuclear power activities for the past nine years. Mr. Allen holds 67 patents as inventor or co-inventor in connection with steam turbines, gas turbines, jet-propulsion engines, and other apparatus for the power machinery field. In 1960, Marquette University conferred on Mr. Allen the honorary DS degree. His activities in ASME include chairman of the Research Executive Committee, 1954–1955; chairman of the Board on Technology, 1959; chairman of the Technical Development Committee, 1959–1960; and member of the Advisory Group of the Nuclear Engineering Division. He was also a member of The Engineering Foundation Board, United Egnineering Trustees, Inc., and of the Technical and Engineering Committee of the Atomic Power Development Associates, Inc. He is a registered professional engineer in the State of Wisconsin.

## D. C. Pfeiffer

David Clifford Pfeiffer, director of the physical plant and professor of mechanical engineering at Southern Methodist University, Dallas, Texas, has been active in engineering practice and in teaching mechanical-engineering curriculums for 37 years. Since his first assignments of mechanical research work on the development of turbine governors, solving vibration problems, and accomplishing thermodynamic designs of steam turbines with General Electric Company from 1922 to 1928, Mr. Pfeiffer has worked continuously for the advancement of design techniques by working actively in creative engineering. He is recognized as an authority on air conditioning and refrigeration designs having pioneered the "storage" type air-conditioning system for commercial and church buildings in the Southwest. With Dr. J. M. Hill, he developed the first large-scale method for the desiccation of human blood plasma, a method known as the Adtevac Process. As a result of this pioneering work during the second world war, much plasma was made available to our soldiers. The Wadley Research Institute of Dallas is an outgrowth of this pioneering work. Much of his work has been in the design and also the modernization of steam-power plants for industry and moderate-sized municipalities. In 1955, he was awarded a citation from *Power* magazine for an outstanding modernization program for the Carey Salt Company, Hutchison, Kan. He is the author of 20 publications and holds four patents. As a consulting engineer during the time he also was teaching courses in advanced steam-power plant design, refrigeration, and air conditioning at Southern Methodist University, he was actively engaged in a variety of consulting engineering work. Included were complete design and specifications for the construction of power-plant additions; designs for U. S. Naval contracts which pertained to the construction of blowdown facilities; a condenser-spray cooling system and construction of laboratory buildings; designs and specifications of steam-boiler installations; electrical and mechanical designs for hospital construction; and work pertaining to compressor and blower installations for a large Texas steel company. Mr. Pfeiffer has been a member of ASME since 1939, and has served as chairman of the North Texas Section of ASME. Also he was a past-president of the Dallas-Fort Worth Section of ASRE; and past-president of the Dallas Technical Club. He is a member of the ASHRAE and a registered professional engineer in the State of Texas.

## H. J. Bauer

Harry John Bauer is a leader in the fields of steam production for district heating and electric power production and in the operation of utility systems. In these areas he has contributed manifestly to the low cost of steam and low cost of reliable electric power in the New York area. He has been instrumental in assessing the need for, promoting, and installing labor-saving devices in power plants, improvement of station heat cycles, installation of equipment which would improve the over-all performance of the plant, and the establishment of new and improved efficiency and cost controls to obtain more economic production of power and steam. As a mechanical engineer with General Engineering and Management Corporation, Mr. Bauer was responsible for the mechanical design of many power stations. He made significant contributions to improve the burning of fine anthracite coal and the design of anthracite burning furnaces at the Whippany, N. J., Station of Jersey Central Power and Light Co. He was responsible for the mechanical engineering work in developing, testing, and placing in commercial operation the first ball mill pulverized fuel boiler burning Illinois coal which was a significant contribution in helping to initiate the trend to the use of coals of low grindability in pulverized form at high efficiency. His experience since 1928 has been with Consolidated Edison Company of New York, Inc., and affiliated companies. As manager of station operation he was responsible for the operation and maintenance of production facilities of the New York Steam Corporation during which time many changes were made in design and methods to improve the efficiency of its six steam generating stations. In 1946, he was elected president of the New York Steam Corporation reporting to the Chairman of the Board of the Consolidated Edison Company, and continued in this capacity until 1954 when the New York Steam Corporation was merged into the Consolidated Edison Company. As vice-president of Consolidated Edison he assumed duties of administering the purchasing, commercial buildings, real estate, transportation, and insurance departments. Now he is in charge of production, responsible for these functions of the electric, gas, and steam systems. Presently, he is assistant treasurer of ASME and has served in the past as chairman of ASME Finance Committee and others. A member of the National District Heating Association, he is a contributing author to their first handbook.

## L. F. Polk

Louis Frederick Polk is president of the Sheffield Corporation, Dayton, Ohio, a leading producer of scientific measuring instruments, cutting tools, gages, automatic gaging and assembly machines, machine tools, and general tooling; and group executive vice-president and director of Bendix Aviation Corporation of which his precision-instrument and machine-tool company is a subsidiary. His honor is conferred in recognition of his more than a quarter of a century of "acknowledged engineering attainment" in the fields of engineering, manufacturing, and precision measurement. As a leader in the field of metrology, he and his company established the Eli Whitney Metrology Laboratory to provide private industry with precise measurement facilities which can now measure to an

Louis Polk, Sr., receives congratulations from and is presented his certificate as Fellow ASME by H. N. Muller, ASME Region V Vice-President, as part of a recent program held by the Dayton Section. As a member of ASME since 1943, Mr. Polk has served as a director and member of the Council and on many national committees.

accuracy of one millionth of an inch. In 1959, Mr. Polk was elected president of the American Ordnance Association after serving as a vice-president in charge of its Technical Divisions and Sections since 1951. Among his honors are the Army Ordnance Gold Medal for Outstanding Service; the Navy Civilian Citation; the Secretary of War's Civilian Citation "for outstanding service in time of war"; and the American Society of Tool Engineers' Gold Medal Engineering Citation. In recognition of his achievements and the caliber of his professional service to the tool engineering profession, Mr. Polk was chosen, in 1957, to deliver the first annual Eli Whitney Memorial lecture established by ASTE. Mr. Polk is author of "Vision in Metrology," "Review of Pneumatic Dimensional Gages," and coauthor of "Dimensional Control" as well as a contributor of numerous technical articles to trade papers. He holds numerous patents, covering a wide range of products, including gages, precision instruments, and machine tools. In ASME he was a director, member of the Council, and chairman of the Board of Codes and Standards; in 1954 he was appointed to serve as director at large. He was awarded an honorary ScD degree by Miami University, Oxford, Ohio, in 1958. Mr. Polk represented the U. S. on pneumatic gaging at the International Conference on Engineering Dimensional Metrology in London in 1953. He is a member of the American Gage Design Committee, under the auspices of the National Bureau of Standards; a charter member of the Air Force League; president of the Sheffield Foundation, an organization which receives and distributes funds for educational, religious, and scientific purposes; member New York Academy of Sciences; and recipient of The John Pottinger Award by the Dayton Chamber of Commerce "for advancement of good will through world trade."

### L. J. Hooper

Leslie James Hooper, director of the Alden Hydraulic Laboratory and professor at Worcester Polytechnic Institute, through his teaching and laboratory work, field testing, and engineering society work has made substantial contributions to the advancement of hydraulics and hydraulic engineering. In 1934–1935 Professor Hooper was awarded the Freeman Scholarship from the Boston Society of Civil Engineers for the purpose of inspecting and studying hydraulic laboratories in the United States and Canada. In 1937, in recognition of his contribution, "American Laboratory Practice," he was the recipient of The American Society of Mechanical Engineers Junior Award. He has been in charge of many projects in the hydraulic laboratory including river model studies of hydroelectric developments including tailrace studies of the Conowingo Development for the Susquehanna Power Company, on the Susquehanna River; the new power development of the Holyoke Water Power Company, on the Connecticut River; the Yale development of the Pacific Power Company, on the Lewis River; and the Pelton development of the Portland General Electric Company, on the Deschutes River; and others. His contributions to the art of measuring large volumes of water has continued and perfected the work of Prof. Charles M. Allen, Hon. Mem. ASME (died, 1954), in a manner that reflects great credit on Worcester Polytechnic Institute and attracts research projects of major importance to the Alden Hydraulic Laboratory. In the period between 1941–1945, Professor Hooper was active in wartime studying underwater missiles. He was a member of the research group at the Underwater Sound Laboratories of Columbia University at New London, Conn. Later he was associated with similar groups using the test facilities at the California Institute of Technology and at Morris Dam, Calif. Since the end of World War II Professor Hooper has been working for the Bureau of Ordnance of the U. S. Navy on the development of underwater missiles. In connection with his duties as member of the Bureau of Ordnance Hydroballistics Advisory Committee he participated in a scientific team visit to England, in 1954, and delivered a paper on a phase of Experimental Hydroballistics at the British Admiralty Symposium. One of the recent projects completed at the Alden Hydraulic Laboratory is a model study of the transient pressures incident to load changes in the power canal and conduits at the Niagara Development under the State of New York Power Authority. His knowledge of hydraulics is recognized in Europe to the extent that he lectured to groups in Sweden, and the United Kingdom, in 1959, before and after his attendance at the Fourth Plenary Session of TC No. 4 (Hydraulic Turbines) of International Electrotechnical Commission, Madrid, Spain, where he was elected International Chairman of TC No. 4. Professor Hooper has been active in ASCE, the Boston Society of Civil Engineers, American Association for the Advancement of Science, as well as serving on many committees of ASME.

Conducted
for the
National Junior
Committee

J.W. FOLLANSBEE[1]

# JUNIOR FORUM

*For the past two years or so the Junior Forum has looked quite a bit into what you—engineers recently out of college—do in industry. This look at our jobs will continue. But it's now time we looked outside the job, rather than just at the job itself.*

*The paragraphs below give one opinion on education. Possibly you agree; possibly you don't. If not, say why. Equally important, say and write what you believe about air and water pollution, noise abatement, unions, specialization, training programs. These things concern you—new engineers—just as well as your boss and the general public.*

*We are right now in the middle of a "thing" society, and it will get more so. To say we're not responsible for the noise, smoke, stink, and damage caused by what we produce is hogwash. You, and I, and every engineer—we're not the only ones responsible. The point is, how much is our fair share; how much belongs to the politician, salesman, machinist, and farmer? One way we can find out is discuss it. Here, on these pages, we can do that. Discuss these things and try to iron them out. Because only until that has happened, regardless of where or how, can we act effectively on these problems. Use this column.*

## The Complete Engineer

Recently there has been much talk about engineers' education. Most of it has been in the form of older men talking among themselves or advising young students or post-students what to do. This is fine. But how do the young men concerned with engineering feel about what's been said? Personally, I think the speakers have missed one vital point. Or at least they haven't made much ado about it. Just what is the purpose of this education? What are we supposed to learn? Or be? Or get out of life? If all it means is achieving the ability to design something, we're not much better than glorified machinists, with all the detriments and none of the advantages. Well, to me it means much more than this.

One of the most important facets of your life is to feel you're complete—a complete person. Regardless of how you say it, it boils down to the fact that you want to feel you've got everything needed to lead a full, complete life. This isn't talking about just money or job skill, but both of these, plus. The plus is understanding. Having an understanding of the knowledge you have. Knowing what it is, where it fits, and why.

Why is this important? Ignorance breeds fear. History proves this. Understanding helps you fight against fear. You usually don't fear those things you understand. Respect them, yes: fear them, no. When you don't understand, regardless of who you are or how you cover it, you fear. These fears may not be big. Rather they are probably small nagging things; but they are there. Understanding helps get rid of them.

Knowledge alone is not too much help. You have to understand what the knowledge means. But once you have this, you'll have the world by the tail. Once you've achieved understanding—of people, governments, relationships—you're well on your way to being complete.

Becoming complete isn't an overnight proposition. The process starts relatively early and goes on for most of your life. For most of you it probably started in college. There you were trained in a logical approach to problem solving. You were trained to get facts, not fancies, weigh what you got, and make a decision. But also you probably were placed in the awkward position of becoming aware of the value of outside knowledge and not quite knowing what to do about it. Many people without an education get along fine without knowing anything except a very little. Most of the doors of knowledge have been shut for them. Yet they've learned to adjust to this. The doors are open to you. But have you been shown how to walk through them?

This is the point of an education, to show you the paths that lead to understanding. Courses in history, philosophy, economics, government, music, art—any or all these were the first exposure many of you had, if you were lucky, to the nonscientific world of knowledge as you entered your adult life. I say lucky, because many engineering schools today still turn out highly skilled problem-solving people, but not educated persons. Here I mean education in the sense of giving the student not only the knowledge of facts and figures but also giving the knowledge of what the facts mean. This works not only for what he learns in college but also for whatever he might meet after graduation. And finally, education implies, to me, an instilling in the student of some benefit—joy, power, peace of mind, what have you—of continually seeking knowledge and an understanding of it.

This is the point the speakers missed. Not whether we—or those coming along—should take four, five, or six years to get the engineering degree, or that the country should create a crash program to turn out the number of engineers people think we need. No These are important, but we also need to include in whatever program is developed at least an indication of the meaning of what they teach us and how it will affect us. The powers that be should not forget in their wrangling over curriculums that, although the country needs engineers, it needs aware engineers, not machines that can't speak anything except formulas.

*J. W. Follansbee.*

## Announcement of Symposium: Fuels—Their Status Today

Man's constantly growing demand for energy, coupled with widely varying opinions as to where this energy will be found at lowest cost, is one of the vitally important problems confronting engineers and technologists. Nuclear power, solar energy, and a host of other sources are being given a more prominent place than they may deserve in our present economy. As a result, conventional fuels tend to be relegated to a secondary position. Yet even the most pessimistic observer realizes that coal, oil, and natural gas will continue to dominate the energy field for many years to come. Hence the time seems ripe for a careful, definitive look at the status of fuels today, that their place tomorrow can be estimated most surely.

The American Society of Mechanical Engineers, through its Fuels Division, is organizing a three-day Symposium to provide an up-to-the-minute viewpoint of the fuels situation. To be held at Rutgers University on June 5-7, 1962, this Symposium will present a series of technical papers covering developments during the past decade in coal, oil, gas, and waste fuels. Authors of the 12 papers are being selected to provide the necessary background and experience to insure comprehensive and accurate reporting. Plans call for preprinting the entire series of papers and for distributing them before the Symposium, that special emphasis can be laid on discussions and comments from the floor.

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[1] Designer, Voorhees, Walker, Smith, Smith & Haines, New York, N. Y. Assoc. Mem. ASME.

**Details of the program are now being settled. Preliminary arrangements are being handled by William T. Reid, Chairman of the Fuels Division Executive Committee. Questions about the Symposium can be sent to him at Battelle Institute, Columbus, Ohio.**

## Actions at the ASME Council Meeting, June 5-6, 1960

The Council met in three sessions during the 1960 Summer Annual Meeting of the Society in the Statler Hilton Hotel, Dallas, Texas; on Sunday, June 5, at 8:40 a.m., adjourning at 12:10 p.m., reconvening at 2:30 p.m., and adjourning at 3:45 p.m., and on Monday, June 6, at 8:40 a.m. and adjourning at 11:55 a.m.

There were present (at all sessions unless otherwise noted) the following:

**The Council.** President Walker L. Cisler; Vice-Presidents: C. H. Coogan, Jr.; T. J. Dolan, Harold Grasse, W. C. Heath, J. W. Little, D. E. Marlowe, and H. N. Muller. G. R. Hahn, who was in Europe, was excused and represented by U. A. Rothermel, Region II Secretary. Directors: E. M. Barber, E. O. Bergman, R. G. Folsom, W. H. Larkin, A. M. Perrin, L. N. Rowley (Sunday), R. B. Smith, and V. M. Smith. C. C. Franck, Sr., and E. W. Jacobson were excused because of other commitments. Past-Presidents: W. F. Ryan and G. B. Warren. Treasurer, E. J. Kates, and Secretary, O. B. Schier, II.

*Chairmen and Members of Boards and Committees.* Constitution and By-Laws, R. W. Miller; Organization Committee, F. L. Schwartz; Finance Committee, E. J. Schwanhausser; Board on Technology, Kerr Atkinson; Agenda Committee, H. A. Jesperson (Sunday) and J. D. Carr (Sunday afternoon); Meetings Committee, W. B. Wilkins (Monday); Boiler and Pressure Vessel Committee, H. E. Aldrich (Sunday); Public Relations Committee, A. C. Pasini; National Junior Committee, M. E. Jansen; National Nominating Committee, T. R. DuBois (Sunday), J. W. McKiernan (Sunday morning), and J. R. Muenger (Sunday morning); and Machine Design Division, Jesse Huckert (Sunday afternoon).

*Regional Delegates.* E. K. Gardner, M. B. Hogan, and S. P. Kezios. On Sunday, W. P. Berggren, E. C. Blackard, T. Howitt, Jr.; R. Neuendorffer, G. E. Pankrantz, A. A. Rasmussen, and C. E. Redfern. On Sunday afternoon, E. E. Burroughs, Edward Miller, P. T. Paraskevas, G. E. Shimp, J. M. Simonsen, and F. R. Thomas, Jr.

*Visitors.* D. J. Bergman (Monday), G. H. Howell (Sunday afternoon), A. K. Ingraham, J. W. Medlin (Monday), R. C. Robertson (Sunday), R. L. Nugent, C. G. Parker (Sunday afternoon), L. J. Romzick, H. H. Snelling, and K. M. Wilson (Monday).

*Staff.* T. A. Marshall, Jr., senior assistant secretary; W. E. Reaser and S. A. Tucker, assistant secretaries; H. I. Nagorsky, Controller; D. B. MacDougall, associate head, Field Department; J. T. Reid, Research Manager (Monday); and Maurice Barrangon, Editorial (Sunday).

The following actions are of interest.

**Constitution and By-Laws Committee.** *Amendments to the Constitution.* The Secretary reported on the Tellers report of May 17, 1960. (See Mechanical Engineering, July, 1960, page 117.)

*Amendments to By-Laws.* The Council voted to adopt the amendments to Article B5, Par. 4; Article B6A, Pars. 10, 11, 12, 13, 14, 14-A, 14-B, 14-C, 14-D, 15, 15-A, 15-B, 15-C, 16, 16-A, 17, 17-A, 17-C, 18, 18-A, 18-B-4, 18-C, 19, 19-A, 20; Article B7, Pars. 1, 6, 13, 14; Article B9, Par. 1; Article B10, Par. 4; and Article B11, Pars. 7, 9.

*Change in Administrative Year.* Realizing that the change in the administrative year will require the extension of the term of office by six months of all Council members elected on the September ballot, the Council in accordance with Article B6, Par. 4, voted to include an explanation on the ballot for new officers so that the exception to Article C7, Section 4 of the Constitution and By-Laws will be concurred in by the members for this slate of officers.

*Amendments to the Rules.* In accordance with the acceptance of the report of the Regional Delegates, the Council voted to approve the amendments to Article R7, Rules 4, 7, and 8; and Article R16, Rules 1, 4, and 5. The following Rules, approved by the Council on Nov. 29-30, 1959, Article R7, Rule 1; Article R9, Rule 1; and Article R10, Rule 2 became effective June 5-6, 1960, when related By-Laws were adopted.

**Board on Education.** *Standing Committee on Scholarships and Student Loan Funds.* The Council voted to delegate to the Board on Education the responsibility of appointing a Standing Committee under the Board to handle the matters relative to the administration of scholarships and student loan funds of the Society.

**Research Executive Committee.** *Supplements to Research Agreements 84-3 and 7SP-5.* In accordance with the delegation of authority given to the Board on Technology by the Council on Nov. 30, 1959, and with the approval of the Research Executive Committee, the Secretary signed Supplement No. 2 to Research Agreement 84-3 between ASME and Brown University extending the maximum sum to be paid from $73,000 to $88,000; and Supplement No. 2 to Research Agreement 7SP-5 with The University of Michigan extending the expiration date from May 25, 1960, to Oct. 1, 1960.

**Metals Engineering Division.** *Custodian Fund.* The Council approved the establishment of a Custodian Fund for the Metals Engineering Division.

**Special Committee on Regional Affairs.** *Realigment of Regions II, III, IV, and V.* Vice-President Little, Region IV, as chairman of a special committee appointed to study the possible realignment of Regions II, III, IV, and V. The possibility of dividing the present Region IV into two units, thereby adding an additional Region, has been referred to the Organization Committee for consideration.

*Committee on Regional Affairs.* The Council approved the establishment of a Standing Committee on Regional Affairs under the direction of the Council; and delegated authority to this Committee to act directly on matters relating to the establishment, transfer, reorganization, and realignment of Sections, Subsections, Groups, Student Sections, Mechanical Engineering Clubs, and all rules and procedures for their operation within the framework of the Constitution, By-Laws, and Rules within the budgetary limits set by the Council; and requested the Constitution and By-Laws Committee to make the necessary recommendation for an addition to the By-Laws.

**Sections.** *Reassignment of Counties From the North Texas Section to the Mid-Continent Section.* The Council authorized the transfer of the following Counties in Texas from the North Texas

Section to the Mid-Continent Section: Bowie, Titus, Morris, Cass, Camp, Upshur, Marion, Gregg, Rusk, Shelby, Harrison, Panola, Nacogdoches, San Augustine, and Sabine for inclusion in the territory of the Shreveport Subsection of the Mid-Continent Section.

***Reassignment of Parishes in Louisiana From the New Orleans Section to the Mid-Continent Section.*** The Council authorized the transfer of the following Parishes in Louisiana from the New Orleans Section to the Mid-Continent Section: Sabine, Winn, Jackson, Lincoln, Ouachita, Union, Tensas, Madison, Franklin, Richland, Caldwell, Natchitoches, Morehouse, West Carroll, and East Carroll for inclusion in the territory of the Shreveport Subsection of the Mid-Continent Section.

***North-East Florida Section.*** The Council approved the establishment of the North-East Florida Section with headquarters at Jacksonville, Fla., and the territory to cover the following counties: Alachua, Baker, Bradford, Clay, Columbia, Dixie, Duval, Flagler, Franklin, Gasden, Gilchrist, Hamilton, Jefferson, Lafayette, Leon, Levy, Liberty, Madison, Marion, Nassau, Putnam, Saint Johns, Suwanee, Taylor, Union, and Wakulla.

***Palm Beach Section.*** The Council authorized the formation of the Palm Beach Section with headquarters in West Palm Beach, Fla., and the territory to cover the following Counties in Florida: Lee, Hendry, Palm Beach, Martin, and St. Lucie.

***Southeast Group of the Northern New England Section.*** The Council authorized the formation of the Southeast Group of the Northern New England Section with headquarters to be at Dover, N. H., and the territory to cover the Counties of: Rockingham, Belknap, Strafford, Hillsboro, and Merrimack in New Hampshire; and York in Maine.

***New Mexico Section.*** In connection with the realignment of Regions, the Council at its meeting, Nov. 30, 1959, approved the transfer of certain Texas Counties from the North Texas Section to the New Mexico Section subject to approval of the North Texas and New Mexico Sections. The North Texas and New Mexico Sections have approved the transfer.

***Change of Northern New Jersey Section Name.*** The Council authorized the change of name of the Northern New Jersey Section to North Jersey Section.

***Affiliation of Sections With Local Engineering Groups.*** At its meeting on Nov. 29, 1959, the Council withheld approval of the affiliation of the Los Angeles and San Francisco Sections with the California Legislative Council of Professional Engineers pending advice of legal counsel. Upon recommendation of a Committee appointed by the President, the Council voted (*a*) to rescind approval to the Los Angeles Section to affiliate with the California Legislative Council; (*b*) to deny approval to the San Francisco Section to affiliate with the California Legislative Council; (*c*) to direct the Secretary to compose a letter, subject to the approval of legal counsel and signed by the President, containing the following points: 1, San Francisco and Los Angeles Sections must immediately disassociate themselves from the California Legislative Council; 2, explain the inconsistent previous actions by the Council in this matter; 3, reiterate the philosophy of why this action must be taken; and 4, point out that members as individuals may and are urged to meet their civic and professional obligations by supporting such activities through suitable channels; and (*d*) to refer this matter to the Constitution and By-Laws and Organization Committees for examination and recommendation for modification of the Constitution, By-Laws, and Rules as well as Council Policies to tighten control as necessary to prevent recurrence of this situation.

**Citrus Conference.** Vice-President Little, Region IV, reported that successful Citrus Conferences under the auspices of the ASME Florida Section have been held during the past five years and that the Florida Section would welcome some assistance from one of the Professional Divisions. Vice-President Little was advised that an invitation for such assistance should be extended by the Florida Section to the ASME Professional Divisions Planning Committee.

**1960 Winter Annual Meeting.** The Council's schedule of meetings was approved. The following suggested topics for the Joint Conference of the Council, Boards, and Standing Committees to be held Sunday evening, November 27, were referred to the Executive Committee of the Council for final decision: (*a*) What is Mechanical Engineering? (*b*) Engineering in the Twenty-First Century; (*c*) The Place of the Mechanical Engineer in Our Society; (*d*) Obligations of the Engineer; (*e*) How Can We Serve Our Members Better?

**Annual Report.** The Council authorized the preparation and distribution of the 1960 Annual Report of the Society to all members as a supplementary edition to the January, 1961, issue of MECHANICAL ENGINEERING.

**Regional Delegates Conference.** The Council voted (*a*) to receive the report of the 1960 Regional Delegates Conference; (*b*) to approve Item No. 6, using one envelope for ballot returns, and Item No. 43, changing the Society's regional and administrative years to July 1 through June 30; (*c*) to approve the necessary amendments to the By-Laws to permit these changes; (*d*) to refer the other recommendation to the committee concerned for report to the Executive Committee of the Council in September; and (*e*) to express sincere appreciation to the Regional Delegates for their efforts on behalf of the Society. Certificates were presented to each Regional Delegate by President Cisler.

**Engineering Societies Personnel Service, Inc.** Upon reviewing the financial status of ESPS, the Council voted (*a*) to recommend that ESPS reorganize itself to live within its income; and should this not be accomplished, (*b*) to recommend the discontinuance of the service as the ASME will not lend financial support to ESPS; and (*c*) to advise the other Founder Societies of this action.

**Unity of the Profession.** ***ASME Advisory Committee on Unity.*** A report of the Committee and a report of the Task Force of Past-Presidents were distributed for study prior to the meeting. After some open discussion, the Advisory Committee on Unity was charged with the task of presenting a plan which might be proposed to the current presidents of the Founder Societies and NSPE.

**Member Gifts Campaign.** President Cisler reported on the status of the campaign. (See pp. 100-101 of this magazine.) The Council authorized the National Member Gifts Committee to study the feasibility of installing a plaque in the reception room of ASME to recognize those individual members, Sections, and Professional Divisions who have given generously; and to report to the Executive Committee of the Council in September.

**Société Royale Belge des Ingénieurs et des Industriels.** The Council voted to send greetings to the society on the occasion of its 75th Anniversary and to designate J. D. Wilding Honorary Vice-President to represent the Society at the ceremonies held June 21–24, 1960, in Brussels, Belgium.

**Pan American Federation of Engineering Societies (UPADI).** The Council recommended to EJC that S. E. Reimel be appointed as a delegate to the Seventh Convention of UPADI, Sept. 19–23, 1960, in Buenos Aires, Argentina.

**Elmer A. Sperry Board of Award.** The Council approved the amendment to the Elmer A. Sperry Board of Award Rules providing for a fifth participating society; namely, the Institute of the Aeronautical Sciences.

**Certificates of Award.** *Faculty Advisers.* The Council authorized certificates of awards for the following Faculty Advisers to Student Sections: Robert D. LaRue, Colorado State University Section; and Albert D. Ford, University of New Mexico Section.

*Member Gifts Campaign Chairmen.* Regional Chairman Ernst W. Allardt, Region V, 100 per cent of its quota. Section Chairmen: Erskine Vandergrift, Birmingham, exceeded quota; Charles D. Birget, Central Michigan, more than fifty per cent of members giving; and Albert Chapman, Detroit, exceeded quota.

*Board on Codes and Standards.* H. M. Turner, Chairman of ASA Sectional Committee Y10-Letter Symbols.

*Retired Professional Division Chairman.* John K. Bryan, chairman, Maintenance and Plant Engineering Division.

*Retired Section Chairmen.* 1958–1959, Carl D. Lingenfelter, Hartford; Charles Morgan, San Diego; G. J. Hanks, Jr., West Virginia; W. A. Lineberry, Nashville Subsection; William Cooperman, Northern New Jersey Subsection; and Frank J. Butler, Ohio Valley Subsection; for 1959–1960, G. J. Allman, West Virginia.

*1960 Nominating Committee.* John C. Reed, Chairman; J. W. McKiernan, Secretary; Henry E. Aldrich, J. David Carr, Emmett E. Day, Rodger B. Dowdell, T. Randall DuBois, William E. Hammond, Frank K. Mitchell, Walter B. Moen, and Everett P. Partridge.

*1960 Agenda Committee.* Herbert A. Jespersen, Chairman.

1960 RDC Senior Delegates. Willard P. Berggren, Paul T. Paraskevas, Mervin B. Hogan, Edwin E. Burroughs, George E. Shimp, S. P. Kezios, John M. Simonsen, and Andrew A. Rasmussen.

**Appointments.** *Membership Development Committee.* The Council approved the appointment of Robert J. Heinzman and Ralph P. Pochank as Junior Representatives to the Membership Development Committee for one year, subject to approval by the Organization Committee.

*Presidential.* Tellers—Constitutional Amendments, Herman H. Johnson, S. A. Salma, and William Vopat.

*Vice-Presidential.* Charles G. Parker, Chairman Region I Sections Committee to fill unexpired term of Henry McCabe.

## ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

THESE items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 60 per cent of the first month's salary if a nonmember, or 50 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

NEW YORK
8 West 40 St.

CHICAGO
29 East Madison St.

SAN FRANCISCO
57 Post St.

### Men Available[1]

**Chicago Office**

**Mechanical Engineer,** BSME, MSME; 33; 11 years' ME research and product-development experience. Background in mechanisms, stress, dynamics and environmental analysis of aircraft electronic, ordnance, turbomachinery, and heat-transfer equipment. $13,000. Chicago area preferred. Me-1115-Chicago.

**Project Engineer,** BSME, Mo. Professional License; 39; substantial experience in plant layout, manufacturing methods, product development, economic studies, extensive customer contact during field-work supervision. $12,000. Will relocate or travel as required. Me-1116-Chicago.

**Design Engineer or Stress Analyst,** BSME; 37; 11 years with manufacturer of farm and industrial tractors; engine design; stress analysis and test instrumentation. $9500 minimum. Midwest preferred. Me-1117-Chicago.

**Research and Development Engineer,** BSME; 31; eight years' experience with earthmoving equipment manufacturer; last four years in development of hydraulic controls. Initial work with experimental stress analysis. Available immediately. $8500. Midwest. Me-1118-Chicago.

**Mechanical Engineer,** BS(ME) MBA; 32; 1953 to date with same organization; started as recent graduate, promoted to project engineer in research, **design,** development, and installation of food-processing equipment. Chicago area only. Me-1133-Chicago.

**Application, Sales, or Service Engineer,** Bradley Univ., BSIE, 1950, BSME, 1955; 36; $3^{1}/_{2}$ years department of multiplant company which manufactures thermostats, relays, switches; one year product design, one year product evaluation, one year administrative engineer, half year senior production engineer, one year design aircraft components; two years sales engineer, gaskets and oil seals to OEM distributors; two years field engineer, gas-fired boilers and water heaters. $9000-$9500. Midwest or Great Plains. Me-1134-Chicago.

**Engineer,** small plant-production management, BSME; 42; purchasing, installation, service, operating, testing of electrical, mechanical, and hydraulic power machinery, office management, order handling, warehousing. $8000. Location immaterial. Me-1135-Chicago.

**Research and Development Engineer,** BS and MS(ME); 29; six years' experience in R&D for nationally known engineering and research organizations. Experience entails application of engineering mechanics (dynamics, vibrations, stress analysis, fluid mechanics, lubrication, machine design, engineering mathematics) and laboratory analysis to machinery and structural problems. $9000. Chicago area. Me-1136-Chicago.

**Maintenance Superintendent,** BS(ME); 37; seven years' experience in maintenance of power-plant equipment. Presently in charge of maintenance in modern coal-burning plant of 332 mw capacity. Four years' experience in testing plant equipment and maintaining instruments and controls. $12,000. Middlewest or West. Me-1137-Chicago.

**New York Office**

**Member of Staff,** PhD, ME, experienced in manufacture, design, development, research, administration. $15,000. East. Me-839.

**Manager, R&D,** BSEE and postgraduate work, experienced in electrical, mechanical, and industrial engineering. $15,000. Location immaterial. Me-840.

**Chief Engineer or Plant Manager's Position Desired;** BSME, PE; 12 years chemical-plant engineering and design, administration; three years engineering sales. Extensive construction, maintenance, and electrical experience. Over $11,500. Either coast, foreign service considered. Me-841.

**Mechanical Engineer,** PE, experienced in installation of mechanical equipment of buildings and medium power plants, at responsible levels, including plumbing, mechanical, and sprinkler systems. Seeks connection with contractors or professional engineer. Open. East-near central location. Me-842.

**General Manager, Works Manager, or Factory Manager,** ME, 18 years' experience in charge of various types of metalworking plants; heavy experience in labor relations. $18,000, plus. East. Me-843.

**Chief Engineer** for designer and manufacturer of heavy, quality, mechanical industrial equipment. Over ten years' successful experience including design, policy determination, customer contact, planning and organization, personnel selection and training, research and development, plant engineering, and maintenance. Open. Northeast. Me-844.

**Mechanical Engineer,** with consulting engineering firm, preferably specialized in heating, ventilating, and air conditioning; BME; recently released from U. S. Navy. $6300. Westchester County or New York City. Me-845.

**Manufacturing Engineer or Plant Superintendent,** ME; practical manufacturing engineering. Precision metalworking. R&D. Development of complete manufacturing processes from operation planning to shipping. Line management of production operations. Creation of means to solve unusual mechanical problems. $10,000 minimum. Location immaterial. Me-846.

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[1] All men listed hold some form of ASME membership.

**Design, Development Engineer,** diesel engines, BME; 45; 17 years' experience in engine-development lab: design cylinder head and combustion chamber, test engines, test apparatus valve mechanism, engine balance. Four years tractor-engine layout and installation. PE, N. Y. $8600. East. Me-847.

**Sales Engineer,** BSc Engineering Brown University, 1948; over 12 years' experience in engineering and sale of heat exchangers. Sale of water-tube boilers, vessels, refrigeration equipment. Past five years included managerial duties. $12,000 plus. New York Metropolitan area. Me-848.

**Mechanical Engineer,** BSME, PE; 35; 11 years' design experience with central station steampower plants, including: Evaluation studies, specification preparation, flow diagrams; testing for fluid flow, heat transfer, bulk handling, and coal-combustion systems. $9000. Open. Me-849.

### San Francisco Office

**Tool Design or Detailer, Mechanical-Tool Engineering** (Budapest), 33. Ten years' experience in layout, detail, design, redesign of earthmoving equipment, hydraulic pumps, jigs, fixtures, special tools, electronic components for microchemical laboratory, missile production; manufacturer. $7800. Prefers San Francisco Bay area. Home: San Francisco. Se-1886.

**Teacher, Designer,** MSME, 34. Six years' college teaching in United States and overseas subjects (structure of materials, engineering mechanics, kinematics, thermodynamics). $5000. Prefers Calif., New England. Home: Utah. Se-1507.

**Plant Engineer, Designer,** ME, 47. Licensed ME, Calif.; 24 years' experience in charge of engineering, estimating, plant layouts, mechanical and piping design, construction specifications; supervised engineers and draftsmen, tool engineer for aircraft machining, purchase equipment for process industries, manufacturers. $9000. Prefers San Francisco Bay area. Home: San Francisco East Bay. Se-128.

**Sales, Industrial Engineer,** IE, 37. Four years' manager Mexican office for sales of steelmill equipment. $9,000–$10,000. Prefers Mexico, Latin America. Home: San Francisco. Se-146.

**Project Engineer, Liaison,** ME, 33. Four years' machine design, layouts, preliminary design, liaison for wire and screen manufacturer. Two years' checking drawings for release to shop; grain driers manufacturer. One year estimating, supervising crews, reports for utility. Two years' purchase of controls, machinery, parts, steelsheets for furnace and sheetmetal company. $8400. Prefers San Francisco Bay area. Home: Calif. Se-107.

**Plant Engineer,** ME, 47, 24 years' experience engineering studies, develop layouts, supervise drawings, specifications, select equipment, capital forecasts, charge maintenance, construction for steel castings, forgings manufacturer, foundries. $10,000. Prefers West, Midwest, South. Home: East. Se-103.

**Manager, Section Head, ME,** 31. Experience in cost estimate, budgeting, test plan, schedule, government specifications, reports, design (cabinets, electromechanical devices, test setup), drafting reliability, packaging, cryogenics, foam plastic mass flowmeters, and production engineer. $12,500. Prefers San Jose area. Home Mass. Se-1763.

**Production Engineer,** GenlE, 38. RPE, 15 years' experience in plant engineering, methods, research and development, processing in major appliance and automotive equipment fields. $10,500. Prefers Calif., Midwest. Home: Ill. Se-1748.

**Electrical Power-System Engineer,** MSEE, 53. Reg. Calif., N. Y., Ore., and Texas. Wide experience with builders, designers, manufacturers in all types of power-system engineering application and supervision; generation, transmission, distribution; planning, reports, design. $14,000. Prefers, Calif. Home: Calif. Se-1897.

**Sales, ME,** 39. Licensed ME Calif.; 20 years' sales of commercial water heaters, air conditioning, pumps, controls, ventilating, agricultural machinery; ten years' construction, installation, maintenance of equipment for contractors, manufacturers. Salary open. Prefers: San Francisco Bay area. Home: San Francisco East Bay. Se-387.

**Designer, Draftsman,** ME (Holland), 32. Three years' experience design aircraft components, cost estimate, co-ordinate purchasing, schedule, instruction, preliminary run until accepted by production. Also some experience on tool design of fixtures and parts. $6600.

## Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

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Please Print **ASME Master-File Information** Date

LAST NAME FIRST NAME MIDDLE NAME

POSITION TITLE NATURE OF WORK DONE

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) Division, if any

*☐

EMPLOYER'S ADDRESS City Zone State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS City Zone State

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PRIOR HOME ADDRESS City Zone State

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☐ Mechanical Engineering — 10th of preceding month
☐ *Journal of Engineering for Power*
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} 20th of preceding month
☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation
☐ B—Applied Mechanics
☐ C—Management
☐ D—Materials Handling
☐ E—Oil and Gas Power
☐ F—Fuels
☐ G—Safety
☐ H—Hydraulics
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☐ L—Process Industries
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☐ N—Machine Design
☐ O—Lubrication
☐ P—Petroleum
☐ Q—Nuclear Engineering
☐ R—Railroad
☐ S—Power
☐ T—Textile
☐ U—Maintenance and Plant Engineering
☐ V—Gas Turbine Power
☐ W—Wood Industries
☐ Y—Rubber and Plastics
☐ Z—Instruments and Regulators

Prefers San Francisco Bay area. Home: San Francisco Bay area. Se-393.

**Construction Manager,** CE, 48, 12 years' reports and design; 14 years' construction-office engineer to superintendent. Experience in coordinating construction, various types contracts and subcontracts. $9600. Prefers Southeastern or Central Calif. Home: Idaho. Se-1864.

**Manufacturing and Sales Manager, Engineering Administration,** 37, ten years' experience in charge of manufacturing phases (responsible for selection, training, and initial guidance of manufacturing representative countrywide, charge of sales) and processing methods (tool design, manufacturing core drive-mechanics); manufacturing companies. $13,500. Prefers San Francisco Bay area, West. Home: Ill. Se-533.

**Senior Mechanical Engineer or Machine Draftsman,** ME, 30. Emphasis in school on board design work. Thorough training in practical design drafting along with theory. Desires work that requires persistence and involves practical design, installation, or layout drafting. $4800. Prefers San Francisco or San Francisco East Bay. Home: Calif. Se-529.

## Positions Available

### Chicago Office

**Mechanical Engineer,** graduate, 28–35, good background in machine design, construction, and equipment layout. Responsibilities will include planning, design, and plant layout in connection with new processing facilities in a rapidly expanding company. Idaho. C-8189.

**Research and Development Engineer,** graduate mechanical or chemical, to 45; for research on general packaging. Will head up process development in paper converting and plastics. Will be responsible for supervising department of about 40 engineers and technicians. Modern laboratory full equipped, for a container manufacturer. To $17,000. Company will pay placement fee. Chicago, Ill. C-8185.

**Production Control Manager,** graduate or equivalent, to 55, at least 5 years' experience in development of manufacturing departmental capacities and machine loading for purpose of planning, scheduling, and controlling production in plant employing at least 750. Will be responsible for planning, scheduling, and controlling all production involved in a multiplant, custom, and volume shop manufacturing several lines of wood and steel professional and laboratory furniture related to raw materials, materials in process, and finished goods. Must be good organizer and capable of reorganizing a department. Previous experience with mechanized data systems such as IBM preferred. Will supervise warehouse, shipping, and receiving foremen; product line supervisors; inventory control supervisors; chief storekeeper; traffic manager and nonexempt factory and office employees. $10,000–$12,000. Employer might negotiate fee. Wis. C-8181.

**Mechanical Engineer,** several years' experience in machine design similar to foundry or road-building machines. Small company with worldwide sales. $8500–$10,000. Okla. C-8165.

**Mechanical Power-Plant Engineer,** graduate, at least ten years' experience in mechanical utility-power-plant management. Must know utility operations. Will make studies of most feasible plant location from economical standpoint. Contacts will be at high-executive levels, limited travel. Position with a consultant. $12,000–$15,000, depending upon experience. Employer will pay placement fee. Chicago, Ill. C-8151.

**Senior Design and Development Engineer,** graduate mechanical, to 45, at least five years' experience in product and machine design, for company which designs and builds own machinery for coating and wrapping industrial process piping. Duties will be to design new and improve present equipment to speed up and save labor. Will be in charge of engineering department of 12. $12,000–$15,000. Employer might negotiate placement fee. Northwest suburb of Chicago, Ill. C-8147.

### New York Office

**Production Engineer,** 25–35, graduate mechanical, with a metallurgy minor desired, practical experience in production engineering involving the metalmaking or metal-fabricating industry; equipment design experience; familiarity with various kinds of metals and their characteristics; some knowledge of factors affecting the structure and constitution of alloys. Under direction, will be responsible for providing technical service to all departments in materials division for the purpose of improving and development, maintenance and economic utilization of division's facilities to produce maximum quality at minimum cost. Conn. W-9268.

**Manager-Chief Engineer** to supervise the running of a small plant and the engineering and design of mechanical grab pick up machinery. About $12,000. Company pays placement fee. Conn. W-9260.

**Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members; $4.50 per quarter or $14 per annum for nonmembers, payable in advance.**

**Plant Industrial Engineer,** at least five years' experience in wage incentives, standards, methods planning, work simplification, and cost reduction. $9300–$9900. Upstate N. Y. W-9259.

**Sales Engineer,** mechanical degree, machinery sales experience, to sell bag and packaging machinery and equipment. To $9000. New York, N. Y. W-9256.

**Personnel Assistant,** degree in labor relations, psychology, or business administration, graduate work favorably considered. Some general personnel experience including employment interviewing. Will be in charge of recruiting activity including the hiring of manpower, advertising, agency contacts, screening, etc., and will assist in the co-ordination of management development program. To $8500. N. Y. State. W-9253.

**Engineers.** (*a*) Process engineer, BS or master's in engineering, some experience in machine design and maintenance. Interested in the installation, operation, and maintenance of complex equipment in the plastics industry. $6500–$8500. (*b*) Junior engineer, BS mechanical or chemical engineering. One to three years in packaging or a related field and an interest or training in economic analysis. $6500–$7500. (*c*) Junior engineer, experience as afore-mentioned. However, instead of economic training should be interested in mechanical devices. N. Y. State. W-9248.

**Boiler Design Engineer,** graduate mechanical or equivalent, minimum of five years' experience in design, development; project engineering on all types of boilers, watertube, firetube, and waste heat, high and low pressure. Heat-recovery experience desirable. Open. Pa. W-9245(*a*).

**Professor for Mechanical Engineering Department,** master's degree desirable. Capable of teaching fluid mechanics, thermodynamics, and heat transfer. New England. W-9241.

**Chief Product Engineer,** mechanical graduate, 35–50, minimum of five years' supervisory experience at the level of section head within a product-engineering department. Some experience in the electrical or electronic field. Should be familiar with stamped and machined components and a background in office machine, aircraft, automotive, or major appliance industries. With full responsibility for all phases of design engineering, product design, together with related research and development functions. $12,000–$14,000 a year. N. Y. State. W-9239.

**Industrial Engineers,** industrial or mechanical engineering degree, none to five years' experience in methods and procedures analysis and evaluation, preferably in the heavy steel or alloy tank business. Duties will include studies directed at cost savings both in manufacturing and possibly in office areas and may include plant layout work. Salary open. Company will pay placement fee and moving expenses. Western N. Y. State. W-9229.

**Mechanical Engineers.** (*a*) Designer. Will be responsible for the mechanical design of research prototype equipment used in the manufacture of semiconductor materials. (*b*) Designer with one to five years' experience for work in process-system design. Should be familiar with applications of chemical-process equipment. Work involves application and modification of existing equipment, plant layout, equipment sizing, utilizing both wet and dry-processing techniques, and specs preparation. Salary commensurate with experience and ability. Midwest. W-9227.

**Engineers.** (*a*) Senior mechanical engineers, graduates, five to eight years' experience in any of the following fields: Component evaluation, specifications and design, circuit design utilizing rotating servo components, including precision potentiometers. Some of this experience should have been with a potentiometer manufacturer. $9000–$11,000. (*b*) Quality-control manager who has worked as assistant to quality-control manager on electromechanical devices. $8000–$10,000 a year. Westchester County, N. Y. W-9211.

**Senior Project Engineer,** graduate mechanical, strong technical background derived from substantial experience in design and development of special machinery and mechanisms, particularly in the packaging-machine field. Heavy administrative and executive skills required. Will direct design and development of machinery to meet customer needs; supervise redesign of standard machines to reduce cost and improve performance; initiate engineering projects, procedures, and programs to improve engineering functions. $15,000 to start. East. W-9209.

**Engineers.** (*a*) Manager of semiworks manufacturing, degree in mechanical or chemical engineering, and experienced in manufacturing supervision in the process industries. $10,000–$15,000. (*b*) Senior process engineer, BS in engineering, at least three years' direct experience in printing films, partly by flexography. Will be assigned in the commercial development department of research and development. $7000–$11,000. N. Y. State. W-9204.

**Senior Designer,** at least ten years' supervisory design experience on heating, ventilating, and air-conditioning systems for commercial and industrial buildings. $10,000–$12,000. New York, N. Y. W-9190.

**Assistant Sales Manager,** Northeastern Replacement Sales and Service Division, ME degree preferred, experience in selling and servicing industrial and automotive distributors. Sales management experience; preferably with bearings experience. Travel approximately 30–40 per cent of time. Headquarters, central N. J. W-9186.

**Senior Mechanical Engineer,** graduate, N. Y. State PE license, and at least five years' design and specification experience in heating, ventilating, and air-handling fields including nuclear radiation. $10,000–$12,000. New York, N. Y. W-9172.

**Mechanical Design Engineer,** graduate, 26–35, three to six years' mechanicl design experience, including $1\frac{1}{2}$ years actual board work. Experience should be with precision components. Familiarity with hydraulics, materials, military design practices, and specs desirable. Will be responsible for mechanical design for precision electrohydraulic components. $8000–$10,000, plus profit sharing and exceptional supplementary benefits. Company pays placement fee, relocation, and interviewing expenses. Apply by letter, including present and expected salary. Buffalo, N. Y. area. W-9165.

**Senior Engineer,** 35–45, mechanical graduate, to be in charge of a new product development department, on light precision mechanical products and machinery. Some knowledge of pneumatics and creative ability desirable. $12'-000–$15,000. R. I. W-9154.

### San Francisco Office

**Field Engineer,** ME, minimum five years' experience, preferably more, in heavy pipe detailing and layout. Knowledge of pumps, fans, blowers, and other equipment encountered in hydraulic powerhouse. Should be able to make field changes and designs, expedite materials, work up bills and materials, assist superintendent, keep track of progress. Salary commensurate with experience. For an engineering-builder. S. D. Sj-5402-R.

**Estimator,** ME, recent grad to two years' working experience with interest and aptitude in training for take-off and estimating heavy piping, fans, pumps, blowers, etc. For heavy equipment installation. For an engineering-builder. Salary competitive. San Francisco. Sj-5401-R.

**Plant Engineer,** ME, under 40, well-qualified in maintenance, procedures, new equipment, power, water, steam, and able to supervise some board work, preferably in food industries. Capabilities to assume complete responsibility in three-plant operation of $500 thousand to $1\frac{1}{2}$ million dollar value. For food-packing company. $650–$850. San Francisco Peninsula. Sj-5396-R.

**Outside Sales,** preferably civil or mechanical or equivalent experience. Familiar with pumps and application and must be sale-minded. Minimum five years' experience in outside sales. $600–$700. Sacramento. Sj-5386.

**Inside Office Engineer,** CE or ME. Some engineering knowledge and office management experience. Interest in doing detail work. To do pump application work, postorder handling, general office management. $600–$700. San Francisco Peninsula. Sj-5385.

**Sales,** preferably with engineering degree (ME, EE, ChE, IE), 25–30. Previous experience not necessary but helpful. Will work in laboratory to become familiar with material; some training. Car furnished. $500–$650, plus benefits. Los Angeles. San Francisco, headquarters. Sj-5384.

**Design, draftsman,** engineering background. Some to extensive experience drafting and assisting designers on piping for refinery, chemical plants, steam power plants. For the refinery and piping division of a large engineering builder. $400–$700. San Francisco. Sj-5373.

**Design Project Engineers,** ME or ChE. Experienced and completely familiar with process design work for chemical plant. Should be able to relate all phases of this type of work from beginning to end. For an engineering builder. San Francisco. Sj-5372.

**Design Engineers,** ME. Well qualified by recent and substantial experience to detail with major design and engineering problems relating to complete steam power plant. For an engineering builder. San Francisco, Sj-5371.

**Industrial Sales Engineer,** engineering degree, 28–40. Well qualified by recent experience to promote and sell regulators, pneumatic and electronic recorders, transmitters, valves and controllers, pressure temperature and humidity to OEM accounts, processing industries, wholesalers, and consulting engineers on a noninstalled basis. For Seattle, Los Angeles, Portland, and Oregon. For a manufacturer. $7200–$10,000. Sj-5362.

**Sales,** engineering degree. Well qualified by current experience to deal with West Coast users of semiconductor base materials. Should know clientele and be thoroughly familiar with marketing and uses of semiconductor materials. For a manufacturer. $12,000, plus incentive and bonus. West Coast territory. Sj-5360.

**Field, Office Engineer,** CE, ME, or other degree, under 30, preferably with minimum of two years' work experience with military training completed. Some familiarity with construction plans, specifications, and building methods. Train for ten weeks in Eastern headquarters, return to inspection work relating to fire insurance. For a district office. Some Northern California travel. San Francisco headquarters. Car required. About $6000. Sj-5358.

**Construction Sales Engineer,** engineering degree, 28–45. Well qualified by experience in contacting architects, contractors, consultants, and specifications engineer in private and public business relative to purchase and use of pneumatic and electronic temperature, humidity and air-conditioned controlled systems including regulators, controls, valves, and specialty items. Must be able to sell, layout, estimate price, quote, process, and administer a project of substantial size to completion. Personnel needed for Sacramento, Denver, San Francisco, Los Angeles, and Seattle. $7200–$10,000, plus fringe benefits, profit sharing, car and business expense. Sj-5351.

**Plant Engineering and Production,** ME, EE, MetE, 30–50. Seven to 20 years' working experience related to ore reduction and milling; one mechanical engineer, one electrical engineer familiar with heavy electrical usage, and one metallurgical engineer for production control. Must have 7 to 20 years' of good solid experience and be familiar with equipment and work in an ore reduction and metals processing plant. Salary commensurate with experience. Nev. Sj-5349.

**Junior Chemical and Mechanical Engineers,** ChE, ME, up to five years' experience (preferably petroleum, petrochemical experience). (*b*) Mechanical engineer, graduate, for mechanical design section of engineering department for design of mechanical appurtenances found in chemical plant. $6420–$6900 or more depending on experience. San Francisco North Bay area. Sj-5345.

**Junior Mechanical Engineer,** ME, under 35. For design of materials-handling systems, structures, and fittings for aggregate asphalt and concrete processing plants. Will assist in coordinating terms of erection and moving stationery and portable plants. About one-fourth time spent out of office. Experience in this field will be advantageous, but not major deciding factor. Running jobs, reports on aggregate and materials plants, as part of construction company. $6000–$6600. Sacramento area Sj-5344.

## CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after Aug. 25, 1960, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

### New Applications and Transfers

#### Alabama

Coulbourn, Edward R., Birmingham
Horton, Reese H., Mobile

#### Arizona

Ambrose, Wilfred G., Winslow
Dumas, Walter A., Tucson

#### California

●Binsley, Robert L., Sepulveda
Chall, Harold J., Castro Valley
Garrick, John D., Inglewood
Heyburn, Donald E., Los Alamitos
●Hsu, William C., Los Angeles
Laituri, M. John. Los Angeles
●McCulla, Robert J., Santa Ana
Miller, Fred L., San Diego
Roberts, Alan J., Castro Valley
●Swanton, Deane M., South Pasadena
Tang, Tung-men, San Jose
Wiese, Robert W., Torrance

#### Colorado

Mount-joy, Donald B., Denver

#### District of Columbia

Willoughby, Willis J., Washington

#### Florida

●Drica-Minieris, Oswald A., Pensacola
Pabst, Lorenz F., Coral Gables
●Williamson, Edward L., Pensacola

#### Illinois

●Chen, Simon K., Chicago
Hayden, Eugene L., Chicago
Mane, Vilas L., Chicago

#### Indiana

●Hammer, James E., West Lafayette

#### Kansas

Indin, Ralph N., Mission

#### Louisiana

●Ruffin, Thomas F., Shreveport
Tompkins, Edward M., Jr., Baton Rouge

#### Maryland

●Fernes, Emil F., Baltimore
Miller, John P., Jr., Frederick
●Sutton, Harry W., Baltimore

#### Massachusetts

●Backer, William R., Worcester
Hesselschwerdt, August L., Jr., Milton
●O'Byrne, Joseph M., Amherst
Seetoo, Ben S., Boston
Thomas, Roy L., Jr., Worcester
●Toong, Tau-yi, Cambridge

#### Michigan

●Collins, Robert V., Detroit
Fink, Robert W., St. Joseph
Jasinski, Ralph, Grand Rapids
Lee, Shi-chung, Detroit

#### Minnesota

Massey, Frank A., Jr., St. Paul

#### Mississippi

Saunders, Charles R., Morton

#### Missouri

Gamble, Richard C., St. Louis
Gelven, Don R., Kansas City

#### Nebraska

Rea, William J., Ralston
●Walling, Randolph A., Omaha

#### New Jersey

Aimone, Robert J., South Plainfield
Atkins, David H., Whippany
Collopy, James E., Kenilworth
Gilson, Hiram B., Chatham
●Rappelyea, Erdman W., North Brunswick
Shvodian, Robert J., Fort Lee

#### New York

●Albanes, John J., Hempstead
Conde, James C., Wellsville
Gollmer, Hugo C., New York
Kathe, David B., Schenectady
Kozak, Andrew L., Ballston Lake
●Marin, Leo G., New York
●Reich, Robert L., New York
Spitzer, Donald A., Maspeth
Stafford, John W., Schenectady
Towle, Wallace R., Schenectady
Worster, Arthur R., Painted Post
Zierak, Stephen J., Wellsville

#### North Carolina

●Lee, John F., Raleigh

#### Ohio

●Barkocy, John L., Stow
Benson, Robert D., Jefferson
Borgerding, James R., Akron
Bressler, Marcus N., Barberton
Carkin, Bruce W., Cleveland
Friese, George F., Barberton
Garten, Herbert, Cincinnati
Grover, Horace J., Columbus
Hayes, James E., Columbus
●Marietta, Robert F., West Richfield
Poor, Richard H., Cincinnati
●Taylor, Arthur R., Cincinnati
Vagins, Milton, Columbus
Wunder, John E., Dayton
Zappa, Oswald L., Mentor

#### Pennsylvania

Bail, John H., Greensburg
●Clark, Alex H., Beaver
Cottilla, Edward J., Jr., Oakford
Fladd, John P., Lancaster
●Herzenberg, Aaron, Williamsport
Roesch, Carl J., Erie
●Shookster, Charles J., Philadelphia

#### Tennessee

●Hardy, Warren J., Chattanooga
Kahn, Judd E., Oak Ridge
Sher, David W., Chattanooga

#### Texas

●Farrar, Boyce F., Jr., Dallas
Hughes, William T., Orange

#### Virginia

Dedrick, Robert L., McLean
●Fullerton, John C., Jr., Richmond
●Reitz, Frederick M., McLean

#### Foreign

Bentley, John R., Maracaibo, Venezuela
Chen, Show S., Keelung, Taiwan, Republic of China
●Chuck, Frank, Maracaibo, Venezuela
Haddon, Michael A., Oakville, Ont., Canada
●Houghton, George L., Toronto, Ont., Canada
Jones, Robert D., Dorval, P.Q., Canada
●Kardos, Geza, Pointe Claire, P.Q., Canada
Kuo, Ming C., Taipei, Taiwan, China
MacRae, Nicholas J., La Oroya, Peru, South America
Maguire, Leonard J., Vancouver, B.C., Canada
Melendez, Jim J., Mexico, D.F., Mexico
Nicholl, Christopher I.H., Quebec, P.Q., Canada
Patel, Prahladbhai K., Ahmedabad, Gujarat State, India
●Sentance, Lawrence C., Hamilton, Ont., Canada
Tang Arcia, Francisco J., Caracas, Venezuela
Tordion, Georges V., Quebec, Canada

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●Transfer to Member or Affiliate.

## OBITUARIES

**Walter Holbrook Adams** (1882–1960), retired consulting engineer, Glendale, Calif., died March 8, 1960. Born, Worcester, Mass., April 17, 1882. Parents, Joseph Cherry and Etta Marie (Holbrook) Adams. Education, BS(ME), M.I.T., 1903; MS, Univ. of Southern California, 1936. Married Annie Marguerite Horne, 1905. Mr. Adams was a specialist in steam power-plant engineering and water systems. He was an assistant in mechanical engineering at M.I.T. from 1903 to 1905; an instructor in mechanical engineering at Polytechnic Institute of Brooklyn, 1905–1908; professor of mechanical engineering at Imperial Pei Yang University, Tientsin, China, 1908–1912; and professor of mechanical engineering at California Institute of Technology, Pasadena, Calif., 1913–1918. After four years in the U. S. Army he became industrial engineer with Imperial Cotton Mills Co., Los Angeles, Calif., and later worked for the city and county of Los Angeles. In 1931 he became master mechanic for Ranchos Los Amigos, Hondo, Calif. In 1938 he joined the public service department of the city of Burbank. Mr. Adams was a colonel in the Ordnance Department of the U. S. Army during World War II and held that rank in the U. S. Army Reserve Corps. He went into consulting practice in 1944. Jun. ASME, 1908; Mem. ASME, 1912. He organized and was first chairman of the Los Angeles Section of ASME. Member, also, Army Ordnance Association, Reserve Officers Association, San Pasquel Lodge of F & AM, Burbank Post of the American Legion, and Burbank Chapter of OES. He was a registered professional engineer in the State of California.

**Henning Julius Berg (1892–1960),** mechanical engineer, Standard Oil Co. of California died in April, 1960. Born, San Francisco, Calif., Sept. 23, 1892. Education, BS, M.I.T., 1916. Mr. Berg spent his entire engineering career with Standard Oil Co. beginning in 1916. He was in charge of surveying and drafting of oil piping layouts and their installation. He later directed the mechanical-engineering division. During World War I he was commissioned an engineering officer in the U. S. Army. Jun. ASME, 1917; Assoc. Mem. ASME, 1921; Mem. ASME, 1935. Member, also, Engineers Club of San Francisco.

**Clarence Albert Dawley (1879–1960),** retired consulting engineer and former owner of the New Jersey Meter Co., Plainfield, N. J., died April 26, 1960. Born, Montrose, Pa., Dec. 23, 1879. Parents, Stephen A. and Frances Emma (Horton) Dawley. Education, ME, Cornell Univ., 1904. Married Helen Louise Ridgway, 1907. From 1904 to 1906 Mr. Dawley was engineer of tests for the Ingersoll Sergeant Drill Co., Easton, Pa. In 1907 he began consulting work, organizing the New Jersey Meter Co. in 1915 which he sold two years ago. He held patents on flowmeters, air compressors, rock drills, a gas engine, and air meters. Jun. ASME, 1904; Mem. ASME, 1912. He was past chairman of the Plainfield Section of ASME. Member, also, Sigma Xi, Cornell Society of Mechanical Engineers, the Cornell Club of Plainfield, and the Engineers Club of Plainfield. He is survived by his widow; two sons, Webster, at home, and Roger R. of Morris Plains; two daughters, Mrs. Frances Herberich of Westfield and Mrs. Nancy Elizabeth Pearson of Plainfield; a brother, Ray, in Florida; and a sister, Mrs. Miriam Fitzpatrick of St. Paul, Minn.

**Gerald Carl Dittman (1900–1960?),** chief engineer of Smith Garden & Erikson, consulting and designing architects and engineers, Chicago, Ill., died recently according to a report to the Society. Born, Chicago, Ill., June 10, 1900. Education, attended Armour Institute of Technology. Mr. Dittman was employed by Neiler Rich and Co., 1919–1928. From 1928 to 1938 he was with Utility Power and Light Corp. of Indianapolis Power and Light Co. He then joined Smith Garden and Erikson. Mr. Dittman was the author of numerous articles appearing in national trade magazines such as *Power Plant Engineering* and *Heating, Ventilating, and Air Conditioning*. Assoc. Mem. ASME, 1926; Mem. ASME, 1955. Member, also, Chicago Association of Consulting Engineers. He was a registered professional engineer in the State of Illinois.

**Joshua Eyre Hannum (1890–1960?),** dean-emeritus of Alabama Polytechnic Institute, Auburn, Ala., died recently according to a notice received by the Society. Born, Concordville, Pa., May 5, 1890. Parents, Howard and Margaretta (Bishop) Hannum. Education, BS, The Pennsylvania State College, 1915; ME, 1920. Married Amy M. Welch, 1916; children, Wallace H. and Mary E. Mr. Hannum had a varied career in engineering and engineering education. He was employed by Skinner Engine Co., Erie, Pa., 1915–1916; was instructor at Purdue Univ., 1916–1918; and industrial engineer for Diamond Chain & Manufacturing Co., Indianapolis, Ind., 1918–1919. From 1919 to 1921 he was head of the industrial department of the Red Cross Institute for the Blind, Baltimore, Md. He was research engineer for the Eyesight Conservation Council, N. Y., 1923–1929; editor of "The Engineering Index," 1927–1936; research engineer for the Association of American Railroads, 1936–1937; and with Crane Co., Chicago, Ill., 1938. In 1938 he became assistant dean and professor of engineering at Alabama Polytechnic Institute. Mr. Hannum was the author of many articles in engineering periodicals and wrote the book, "Eyesight Conservation." Assoc. Mem. ASME, 1919; Mem. ASME, 1935. He was Office Manager of ASME, 1931–1936. Member, also, Tau Beta Pi, Phi Kappa Phi, American Society of Political and Social Science, Illuminating Engineering Society, Institute of Management, AMA, AAAS, and the Society for the Promotion of Engineering Education.

**Wilbert Losson Hindman (1897–1959),** retired tool engineer, Chrysler Corp., Detroit, Mich., died Nov. 1, 1959. Born, Colora, Md., Dec. 15, 1879. Education, attended Carnegie Institute of Technology. Early in his engineering career Mr. Hindman was employed by many machine tool and manufacturing companies including Westinghouse Electric Corp. In later years he was with Dodge and Chrysler Corporations. He was co-inventor of the Hindman Hi Duty Lathe and developed a basic allowance and tolerance system featured in *Machinery* magazine, 1925. Assoc. Mem. ASME, 1914; Mem. ASME, 1935. Survived by his widow, Grace S. Hindman, Detroit, and son, W. L. Hindman, Jr., Los Angeles.

**Harold Merriam King (1888–1960),** test engineer, Atwood & Morrill Co., Salem, Mass., died Feb. 29, 1960. Born, Fitchburg, Mass., March 28, 1888. Parents, Leonard Cozzens and May Anna (Merriam) King. Education, BS(ME), Worcester Polytechnic Institute, 1910. Married Isabel Olivia DeLory, 1920; children, Elizabeth Merriam and Mary Priscilla. Mr. King was an engineering student, General Electric Co., Lynn, Mass., 1910–1912, and became assistant engineer in their turbine department in 1912. He received increasing responsibilities in the company and became section engineer. In 1948 he was granted a professional engineer's license in the State of Massachusetts. Assoc. Mem. ASME, 1914; Mem. ASME, 1935. Mr. King was on the ASME Executive Committee, Boston Section, 1942–1946. Member, also, Massachusetts Society of Professional Engineers.

**John Kupstas (1898–1960),** mechanical engineer in charge of special design, Foster Wheeler Corp., New York, N. Y., died in January, 1960. Born, Shenandoah, Pa., June 24, 1898. Education, ME, Cornell Univ., 1924. Mr. Kupstas was a specialist in applied mechanics. As combustion engineer for Kennedy Van Saun Manufacturing and Equipment Corp., New York, N. Y., 1928–1935, he co-operated in the design and development of the Kennedy Water Wall, an improved pulverized coal distributor, and a new type of pulverized coal burner. During 1936–1940, with Foster Wheeler Corp., he helped redesign a pulverized fuel system. He designed a forced-circulation boiler for the U. S. Navy when he was employed by Combustion Engineering Co., 1940–1943. In 1943 he rejoined Foster Wheeler Corp. and organized a special department for analysis of design and solution of problems beyond the scope of elementary methods of strength of materials. Mem. ASME, 1954.

**Harold John Lockwood (1890–1960),** professor of engineering, Trinity College, Hartford, Conn., died April 15, 1960. Born, New Rochelle, N. Y., Sept. 14, 1890. Parents, Fred H. and Annie (Ferens) Lockwood. Education, EE, Lafayette College, 1912; MS, 1916. Married Elizabeth Van Campen, 1913; children, John A. and Theodore D. Although Mr. Lockwood was a consulting engineer and a registered professional engineer in the States of New York and Connecticut, most of his career was spent in teaching. From 1912 to 1921 he taught engineering physics at Lafayette College, Easton, Pa. He was professor of power engineering at Dartmouth College, 1921–1932, and professor of electrical engineering at Manhattan College, 1938–1942. From 1931 to 1937 he was consulting engineer for the state of New Hampshire and state director for the Federal Emergency Administration of Public Works for Maine, New Hampshire, and Vermont. He was visiting lecturer at Yale University School of Engineering, 1945–1946. He received an honorary MA degree from Dartmouth in 1924. Mem. ASME, 1931. Member, also, AIEE, ASEE, Sigma Nu, Tau Beta Pi, Sigma Alpha, Hartford Engineers Club, and the University Club of Hartford. He had served as a member of the New England Planning Commission and was arbitrator of the Connecticut State Board of Mediation and Arbitration, Department of Labor, in 1947. Surviving are his widow and sons.

**James C. Matchett (1885–1960?),** president and treasurer, Illinois Engineering Co., Chicago, Ill., died recently according to a notice received by the Society. Born, Chicago, Ill., May 28, 1885. Education, BS, Chicago Institute of Technology, 1907; ME, 1912. Mr. Matchett had a long career with the Illinois Engineering Co., beginning in 1912. He was vice-president and general manager from 1923 to 1950 when he was elected president and treasurer. Jun. ASME, 1912; Mem. ASME, 1921.

**Charles Raymond Otto (1914–1960),** senior development engineer, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., died May 1, 1960. Born, Sayville, L. I., N. Y., Oct. 15, 1914. Parents, Louis Alfred and Lena Isabelle Otto. Education, ME, Cornell Univ., 1937, MME, 1946. Married Johanna Huson, 1937; children, Jan Charles, Joann Carolyn, Jason Lewis, Kristin Belle, Neil Frederick, and Eric Peter. Mr. Otto was development engineer with The Solvay Process Co., Hopewell, Va., from 1937 to 1942. He instructed in the metals engineering department of Cornell Univ., 1942–1951, and rose to assistant professor of mechanical engineering. He joined E. I. du Pont de Nemours & Co., Inc., in 1951 as an instrument engineer. Jun. ASME, 1938; Mem. ASME, 1946. Mr. Otto served ASME as chairman of the New York Southern Tier Section, 1949; chairman of the Control Valve Symposium Committee, 1954; chairman, ASME-IRD Education Committee, 1956. He received an ASME certificate for Southern Tier organization work in 1952. He was chairman of the Wilmington Section of ISA, 1955; and vice-president of Newark Recreation Association, 1954. Member, also, ASCE, Delaware Society of Professional Engineers, and the Newark Chamber of Commerce. Survived by his widow, four sons, two daughters, a sister, Dr. Belle Otto, and a brother, Lewis L. Otto.

**Alexander John Phillips (1895-1959),** assistant chief engineer, Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn., died Dec. 15, 1959. Born, Raynham, Mass., May 24, 1895. Education, attended Massachusetts Nautical School, 1916; Cleveland School of Technology, 1921–1922; home study; and courses from International Correspondence School. During World War I Mr. Phillips served in the U. S. Navy. From 1920 to 1931 he was employed by Cleveland & Buffalo Transportation Co., Cleveland, Ohio. He joined Hartford Steam Boiler Co. in 1931. He wrote articles on pressure vessels and power-plant equipment published in *Locomotive*. Mem. ASME, 1944.

**Bruce Robinson Prentice (1906-1960),** European representative for the General Electric Co. atomic-power equipment department, died in Geneva, Switzerland, April 23, 1960. Born, Clifton, Kan., May 24, 1906. Education, BS(EE), Kansas State College, 1930; studied three years in advanced engineering program of General Electric Co. Mr. Prentice, an expert on the use of nuclear power for peaceful purposes, had been with General Electric Co. since 1931. Before going to Geneva he was manager of nuclear designs study for the atomic equipment department in San Jose, Calif. He was responsible for work leading to the choice of the boiling-water-reactor plant as the company's main contender for entry into the commercial atomic power-plant field. This work led to the sale of the 180,000-kw Dresden Nuclear Power Station for the generation of electricity that the department recently completed near Chicago for producing nuclear power for farms and industries in northern Illinois. Before heading the atomic study, Mr. Prentice held a number of administrative and engineering assignments in the company's various atomic-energy activities. Mem. ASME, 1947. He was chairman of the Executive Committee of the Nuclear Engineering Division of ASME, 1957, and was general chairman of the 1958 Nuclear Congress in Chicago. Member, also, ANS, AIEE, and the Engineers Club of New York City. Survivors include his widow, Marguerite, two sons, Rob and Leigh, and a daughter, Susan, in Europe.

**Frank Rasmussen (1874-1960),** retired as district engineer, Link-Belt Co., Chciago, Ill., died April 11, 1960. Born Denver, Colo., Sept. 29, 1874. Parents, Rasmus C. and Anne C. (Jorgensen) Rasmussen. Education, BS(ME), Colorado State Univ. Married Clara Milhening, 1906. Mr. Rasmussen was experienced in materials handling of all types; he specialized in cranes, chain, and belt conveyers. Mr. Rasmussen, who officially retired from the company in 1945 but stayed on long enough to establish a school for promising engineering students, began his career with Link-Belt in 1907 in the engineering department. In 1922 he took over the engineering sales and service of the company in the Loop district in Chicago. Mem. ASME, 1930. He also was a member of Western Society of Engineers and the Society of American Military Engineers. Survived by wife; two children, Milton P. and Josephine L.; and two grandchildren.

**James Arthur Stewart (1882-1960),** retired mechanical engineer, died in Miami, Fla., April 16, 1960. Born, Helensburgh, Scotland, March 31, 1882. Parents, James and Burgess Jamesina Stewart. Education, attended Glasgow and West of Scotland Technical College. Mr. Stewart was a citizen of Great Britain and a licensed professional engineer in the province of British Columbia, Canada. For many years he was with The Air Preheater Corp., New York City. Mem. ASME, 1927. Member, also, Institute of Engineers and Shipbuilders of Scotland and British Columbia Professional Engineers Association.

**Joseph J. Thomason (1895-1960?),** consulting engineer, died recently according to a notice received by the Society. Born, Fredericktown, Mo., July 5, 1895. Parents, Lew R. and Mary Theresa (Berryman) Thomason. Education, high-school graduate. Married Clara Galyean, 1924; children, Clara Virginia and John J. Mr. Thomason spent a large part of his career with Westinghouse Corp. After 1951 he joined J. Frazer Smith Association, engineering consultants, and became vice-president and chief engineer. He was the author of a paper "Street Lighting Practice" published in *Illuminating Engineering*. His series lighting transformer earned a patent which was assigned to Westinghouse. He was a licensed professional engineer in the States of Tennessee, Arkansas, and Mississippi. Assoc. Mem. ASME, 1923; Mem. ASME, 1944. Member, also, AIEE, SAME, and NSPE.

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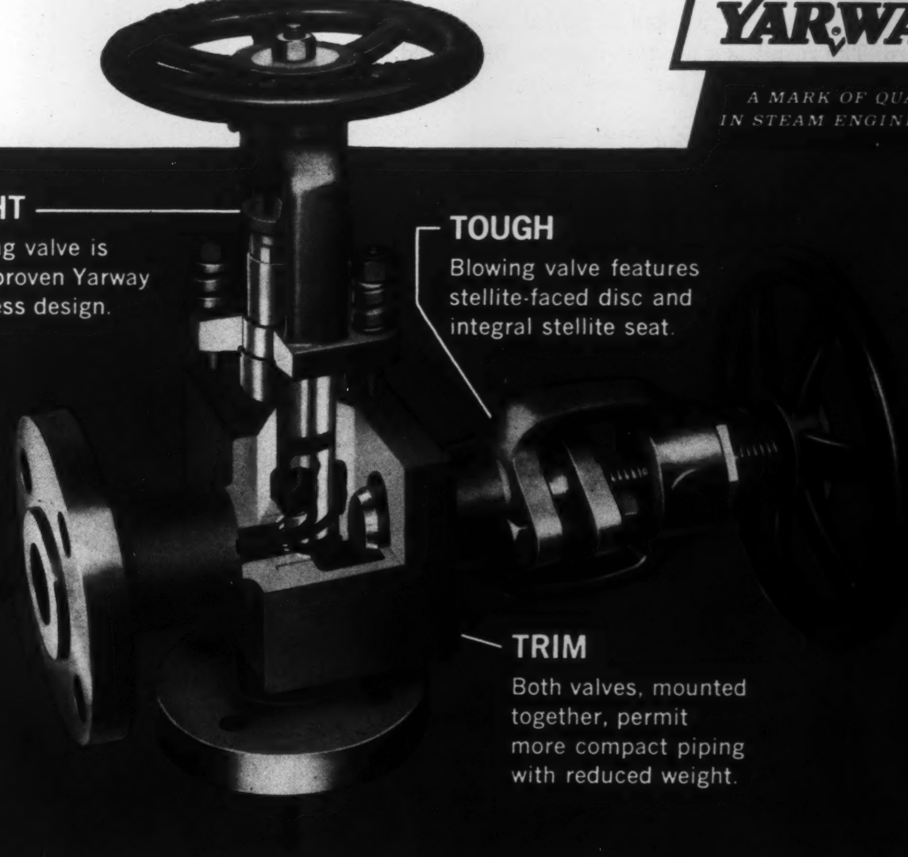

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Sealing valve is time-proven Yarway Seatless design.

**TOUGH**
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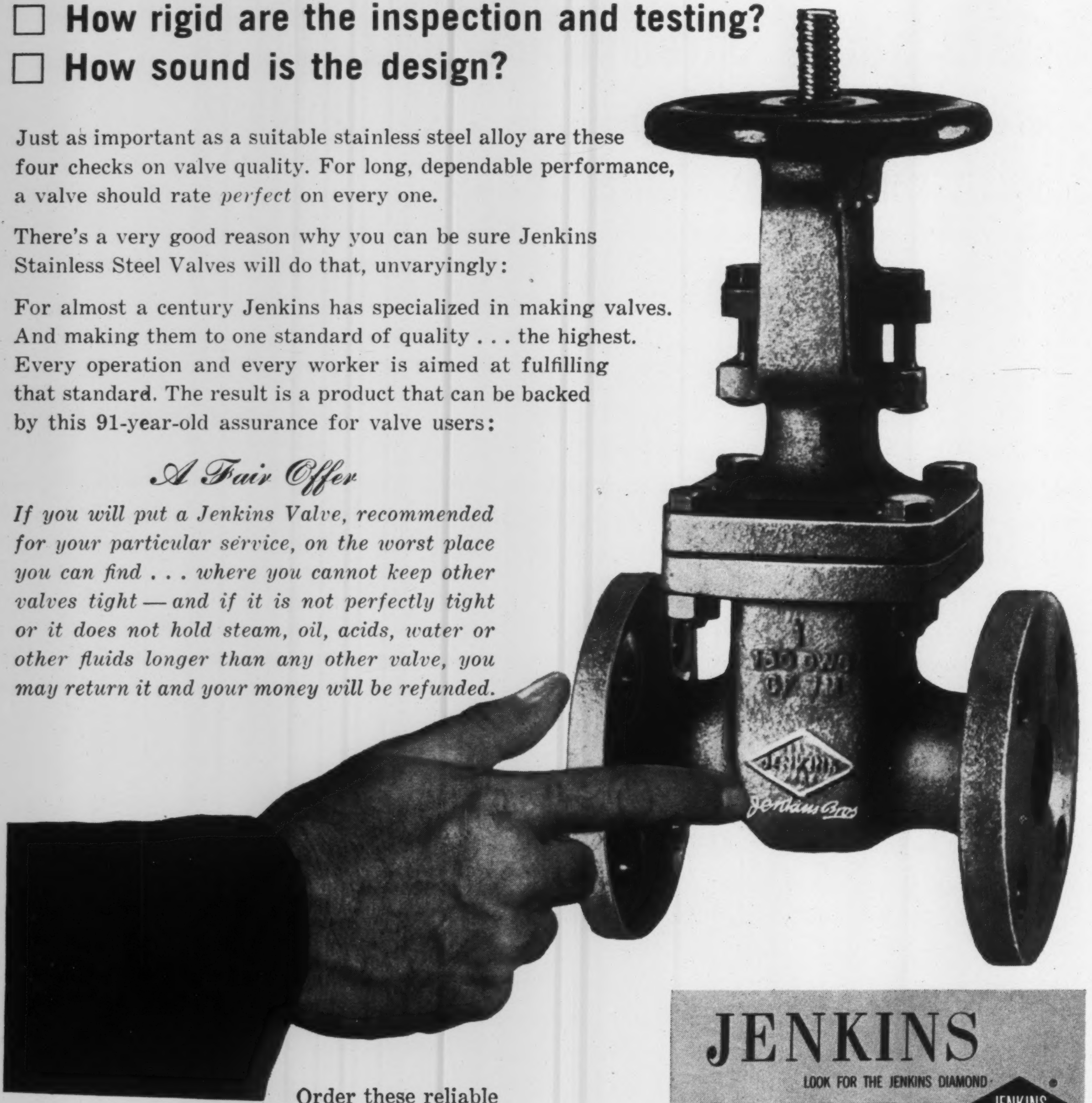

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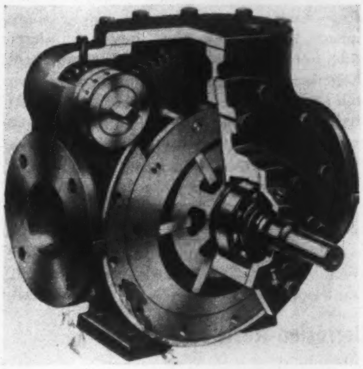
Available literature or information may be secured by writing direct to manufacturer. Please mention MECHANICAL ENGINEERING.

## NEW EQUIPMENT



### Variable-Flow Pumps

A new Vari-Flo line of variable-capacity rotary pumps is announced by Blackmer Pump Co., Grand Rapids 9, Mich.

Any desired flow rate from zero to full capacity to meet a varying liquid condition, such as viscosity, varying delivery conditions, or for flow proportioning may be dialed without changing the pump speed. Thus the pump can be powered with any standard-speed motor and provide all the advantages of more complicated and expensive variable-speed drives formerly needed. Flow can be reversed while the pump is in operation simply by a turn of the dial. This unique feature permits the evacuation of discharge lines when desirable without additional by-pass piping and valves.

The Vari-Flo pump is currently offered in three basic sizes (2, 3, and 4-in.) which provide capacities up to 450 gpm. The pumps are handling liquids up to 85,000 Ssu and operate at a maximum differential pressure of 100 psi.

There is a choice of four Vari-Flo pumps in each of the three available sizes. Two are of the external ball-bearing type, with mechanical seals, one model being specially fitted for handling commercial solvents. The other two are packing-gland pumps for higher temperatures and viscosities. One of the packing-gland pumps is offered with steam-jacketed heads for handling extremely viscous liquids that require heating between operations. Write for Bulletin 600.

### Gear Drive

The Twinducer gear drive, a new compact space-saver drive arrangement for grinding mills, has been developed by Allis-Chalmers engineers.

The Twinducer efficiently harnesses the power of two synchronous motors located on the mill side of the drive. The electrical load is distributed through an angular rotor shift of one of the motors. Once the load is balanced and the rotor locked in place, no further adjustment is needed nor are floating gear or pinions required.

Occupying up to only one half the space required for other gear-box drives, the first application was in connection with two 13 by 17-ft raw-grinding ball mills and two 13 by 21-ft finish-grinding ball mills being supplied a West Coast cement plant. The former mills are driven by two 800-hp synchronous motors and the latter by two 1000-hp machines.

Leaflet 07B9607 is available from Allis-Chalmers, Milwaukee 1, Wis.

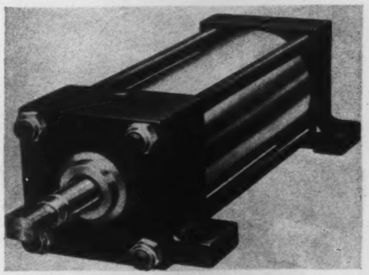
### Elapsed-Time Indicator

A subminiature elapsed-time indicator featuring digital readout is being produced by the Waltham Precision Instrument Co., 221 Crescent St., Waltham, Mass. Designated the WT-3, it weighs just $3^3/_4$ oz, measures $1^1/_{16}$ in. OD × $2^3/_4$ in. max, and operates at 360 to 440 cps with a $2^1/_2$-watt maximum power input. The digital presentation runs to 9999 hr and the numerals are $^5/_{32}$ in. high.

Other important features include jewel bearings, an ultraprecision gear train with a 1.8 million to 1 ratio, and a very low inertia motor. Jewel bearings are incorporated because of their small size, light weight, long life, and operating advantages which include minimum friction, even at temperature extremes, and performance reliability.

With the mean operating time between independent failures being used as an index of reliability (see MIL-R-26474(USAF) 10 June 1959) and elapsed-time indicators incorporated into military electronic ground equipment, the WT-3 was designed to be light and small enough to accompany "black boxes" of critical equipment anywhere. It provides a continuous and easy-to-read record of operational use and life which is applicable for reliability programs and life testing, design and systems analysis, and utilization studies.

The WT-3 meets the enviromental requirements of MIL-E-5272B and is available in production quantities.



### Pneumatic and Hydraulic Cylinders

Mead Specialties Co. announce a new line of square-end double-acting pneumatic and hydraulic cylinders featuring many interesting advances. A unique two-stage cushion assures smooth deceleration of the piston on both pneumatic and hydraulic models. It is fully adjustable from the slightest measurable cushioning effect to complete stoppage, and extremely rapid and smooth advance of the piston rod can be made without the use of ball checks.

Bore sizes are $1^1/_2$, 2, $2^1/_2$, $3^1/_4$, 4, 5, and 6 in. Working media and maximum pressures are: Air, to 250 psi for all bores; oil, to 1000 psi through $3^1/_4$-in. bore, to 700 psi through 5-in. bore, to 600 psi on the 6-in. bore. Cylinders for use with water as medium may be supplied on special order.

Thirteen mounting styles are available. Cylinder heads are made of cold-drawn steel with all surfaces (external and internal) permeated with black oxide for rust prevention. Pipe-port and cushion adjustment location may be chosen by customer on most models.

Several choices of rod diameter are available for each bore size. Leather piston wipers are supplied on all pneumatic models to assure constant lubrication of cylinder bore. A multiple lip rod wiper cleans in two directions and delivers a dry rod on the outstroke avoiding an accumulation of oil on machinery.

Temperature range of the air models is up to 212 F, oil models to 250 F, with cylinders to withstand 400 F available on special order.

Seamless, hard drawn, micro-inch finished brass barrels, high-tensile chrome-plated steel piston rods, accurately machined rod-bearing cartridges are made of bearing bronze, and high-tensile steel tie rods are permeated with black oxide for rust prevention.

For further information, write to the company, Dept. SH-31, 4114 N. Knox Ave., Chicago 41, Ill., asking for "Square Head' Sheet.

**NEW** . . . from Winsmith

SERIES "HM"

*Horizontal Motorized Differential Speed Reducers*

Fits Any
Standard "C"
Flange Motor

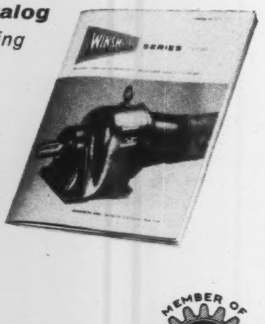
**RATIOS-1.1:1 to 50,000:1**

- *7 Models*
- *.12 to 81.51 H. P.*
- *Max. output torque— 50 to 113,000 in. lbs.*
- *Exclusive unified helical gear planetary element*
- *Overall dimensions of individual models never vary regardless of ratio*

In the new Series "HM", Winsmith offers the widest ratio range available in a Differential Speed Reducer. The "HM" Series is built around the unique Winsmith Unified Planetary Element which automatically equalizes load distribution through the planetary gears. This insures constant smoothness of operation, quiet running and a longer, trouble-free service life.

Winsmith Differential Reducers are in daily use in almost every type of service. They are easy to install, require no bedplate, deliver more horsepower per pound of weight or cubic foot of space and permit easier integration with the driven machine.

● ***Write today for new catalog*** *which contains complete engineering data and selection information.*



WINSMITH
SPEED REDUCERS

**WINSMITH, INC.**

MEMBER OF AGMA

20 Eaton Street, Springville, (Erie County), N. Y.

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### Circuit Holder

A crescent four-way valve made by Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, California, has a built-in circuit holder which simplifies wiring by eliminating the need for relays and relay circuits.

It may be used to control cylinder action on a multitude of tooling set-ups where reciprocating motions are involved.

### Spring Pins

Pins with a spiral cross section, available in $^1/_{32}$ to $^3/_4$-in. diam, provide resilience and high shear strength for a variety of assembling, hinging, and pivoting applications. Called Spirol pins, they have chamfered ends for easy lead in. They assume the shape of the hole radially and grip the hole wall uniformly throughout their entire length although they do not take a permanent set and are easily removed.

Made of 1070 carbon steel, chrome stainless, or nickel stainless with a variety of finishes they can be had in light, medium, or heavy-duty types.

A 10-page technical-data manual is available from C. E. M. Co., 24 School St., Danielson, Conn.

### Corrosion-Resistant Tanks

Poxyglas, a new type of corrosion-resistant tank available in sizes up to 12-ft-diam for use in the storage, transportation, and distribution of corrosive materials, has been introduced by Black-Sivalls & Bryson, Inc.

Epoxy-resin bonded, glass-filament-wound Polyglas offers an entirely new approach to the corrosion problems in tanks, containers, and vessels. The nontoxic, odorless properties of Poxyglas make it ideal for handling products which cannot stand contamination. It is also light in weight and has high strength properties.

Poxyglas is produced by a patented process of combining glass-fiber rovings and thermosetting epoxy resins in a precision winding pattern. The exceptionally strong glass filaments (0.000368-in diam) are wound on a steel mandrel. After the desired wall thickness is reached during the winding operation, the Poxyglas is heat-cured while still on the mandrel. The heat transforms the liquid epoxy into a solid bond between the glass filaments and the resin.

There are no "creep" or "wicking-action" properties sometimes found in molded plastic products. The vessels are designed to operate at atmospheric pressure and temperatures up to 250 F.

For more information, write to the company at 7500 East 12th St., Kansas City 26, Mo.

**For Consulting Engineers**
**Turn to Page 188**

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### Solids-Handling Pumps

A broad line of heavy-duty process pumps with capacities up to 9500 gpm and for heads up to 220 ft are available from Goulds Pumps, Inc. The pumps are especially adapted for handling: Fluids with fibrous, granular, or other type solids in suspension whether abrasive or nonabrasive; thick liquids of all types such as paper stock, starches, slimes, slurries, and so forth; under operating conditions where temperatures up to 350 F and working pressures up to 400 lb are encountered.

Pumps are of the end-suction, vertically split type, featuring back-pull-out assembly which gives ready accessibility to all rotating parts without disturbing pipe connnections. All pumps have 45-deg self-venting discharge connections as standard. Top-horizontal or vertical-up discharge can be furnished on special order. Nonclogging, solids-handling impellers with back ejecter vanes, external adjustment of clearance between impeller and renewable side plates, split glands suitable for quenching and cooling chambers on bearing housings are other features.

Address: Goulds Pumps, Inc., Seneca Falls, N. Y.

### Teflon Seat Rings

Teflon-inserted seat rings, designed as optional equipment for 150 to 300-lb bolted bonnet steel valves (Models 5202F and 5206F) in sizes 2 through 10-in. are available from the Walworth Co., 750 Third Ave., New York 17, N. Y.

These valves are often used in refineries or on refined products, such as lubricating oils, kerosene, and aviation fuels, where an absolutely tight seal is imperative. The resilient Teflon is substituted for one of the metal seating surfaces of the valve giving a tighter closure than is possible with a metal-to-metal seal.

### Lead Dispenser

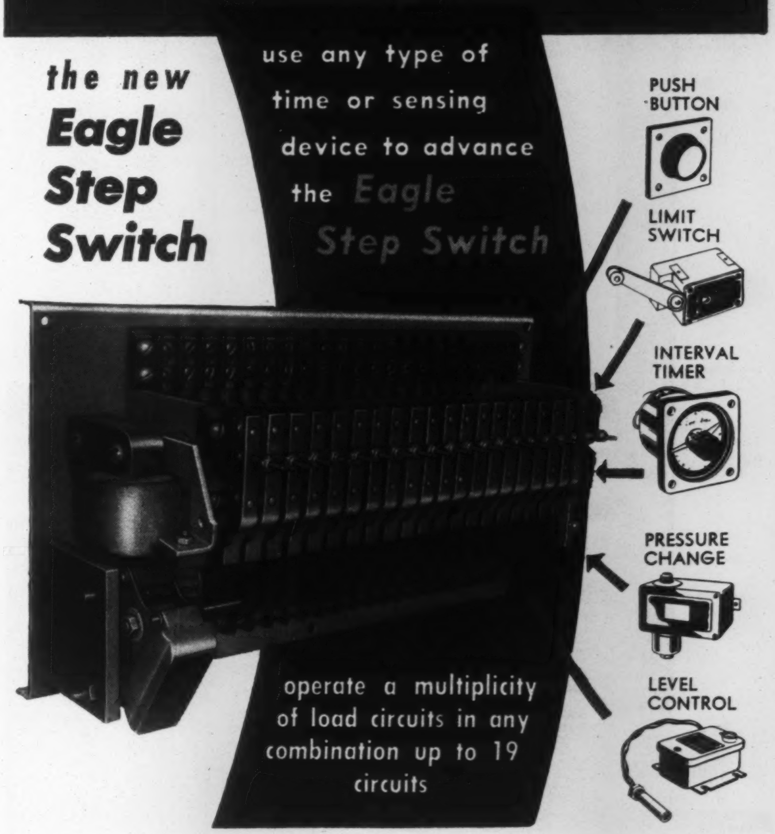
An improved Ejectomatic lead dispenser has been introduced by Koh-I-Noor Pencil Co. Originally introduced as a convenience for the draftsman, it feeds lead automatically to the holder without the need of handling the lead.

The improved version substitutes a spring-action feed in place of the gravity feed formerly used. It makes lead replacement and exchange even quicker and more convenient.

All 17 degrees of Koh-I-Noor drawing leads come packed in the new Ejectomatic lead dispenser. Write to the company at Bloomsbury, N. J.

A NEW APPROACH TO MACHINE PROCESS CONTROL

Step Sequencing



the new **Eagle Step Switch**

use any type of time or sensing device to advance the Eagle Step Switch

operate a multiplicity of load circuits in any combination up to 19 circuits

***This new Eagle Step Switch also provides:***

**1** SEQUENCING INTERLOCK when used with multiple indexing circuits.

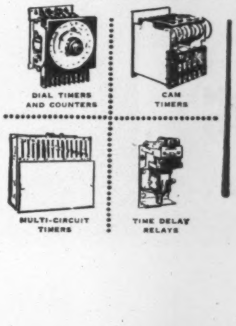
**2** 10 AMP SWITCH CONTACTS control load switches direct—no need for load relays.

**3** MECHANICAL CIRCUIT INTERLOCK by cam action—eliminates interlocking relays.

**4** 115 VOLT COIL operates direct on AC with heavy duty ratchet mechanism—insures long life.

**Write us regarding your count problem, or see your local phone directory or Thomas Register under the heading, "Timers, Electric" for your nearest Eagle Signal representative.**

**OTHER POPULAR HIGH QUALITY EAGLE TIME-COUNT CONTROLS**



BLISS
**EAGLE SIGNAL COMPANY • Moline, Illinois**
A DIVISION OF THE GAMEWELL COMPANY,
AN E. W. BLISS COMPANY SUBSIDIARY

**VISIT US AT THE PRODUCTION ENGINEERING SHOW
SEPT. 6–16, NAVY PIER, CHICAGO—BOOTH NO. 381**

*MANUFACTURERS OF A COMPLETE LINE OF INDUSTRIAL TIME-COUNT CONTROLS*

**POWER REACTORS DESIGN and DEVELOPMENT**

Combustion Engineering's Nuclear Division is expanding its activities in the design and development of high performance pressurized and boiling water nuclear power reactor systems for commercial and military applications.

Staff positions are now available to qualified nuclear, mechanical, electrical and chemical engineers for work in the following areas . . .

REACTOR PLANT ENGINEERING—Design, selection and evaluation of power plant equipment and controls; studies of power plant cycles and economics; mechanical design and structural analysis.

REACTOR ENGINEERING DESIGN—Thermal, hydraulic, and mechanical design of nuclear reactor cores including steady-state and dynamic analysis.

NUCLEAR DESIGN AND ANALYSIS—Design of advanced reactor concepts and shielding employing high speed digital computers; analysis of nuclear fuel cycles.

Located nine miles from the center of Hartford, Connecticut, the Nuclear Division is within short driving distance of some 50 smaller communities. Boston and New York City are only two and one-half hours by car over four-lane divided expressways. Excellent housing and schools are available and New England's famous mountain and seashore areas are readily accessible.

**Address inquiries to:**
**R. M. Killelea, Manager**
**Professional Recruiting**
**Nuclear Division**
**Combustion Engineering, Inc.**
**Windsor, Connecticut**

NUCLEAR DIVISION
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WINDSOR, CONNECTICUT

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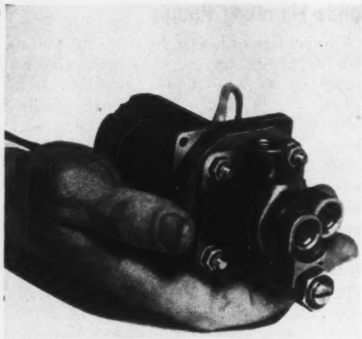

## ECM Cooling Package

A miniaturized vane pump with integral-relief-valve and electric-motor combination is the newest addition to the line of packaged components and systems for aircraft and space vehicles available from Vickers Inc., Detroit, Mich., Div. of Sperry Rand Corp.

The 3.0-lb package, used as a coolant motorpump for electronic countermeasures equipment, ECM, occupies approximately 28 cu in. A significant feature is the replaceable vane-pump cartridge that simplifies service. The miniaturized pump alone, or in combination with hydraulic or electric motors, has found wide use in such applications as small radar drives, small computer drives, fuel pumps, missile skin cooling, flow dividers, and pressure lubrication.

The pump delivers 1.05 gpm at 90 psig. It is nominally rated for 1000-hr continuous duty at operating temperatures ranging from −65 to +160 F at 11,000 rpm. The 115/200-volt a-c, 400-cps, 3-phase electric motor draws 1.5 amp. Larger and smaller flow capacities are available.

## Midget Bearing

A self-aligning bearing, specially designed for small fractional-motor applications, has been introduced by Randall Graphite Bearings, Inc., Lima, Ohio.

Available for shaft sizes of 1/4, 5/16, 3/8, and 7/16 in., this compact self-contained unit is a permanently lubricated bearing with a sintered-bronze bushing. It offers a substantial advantage over old-type sleeve bearings because it is maintenance free; it eliminates the need for oil lines, reservoirs, oil cups, wicking, oil slingers, catchers, etc.

Installation is quick and easy with only minor change in the end bell housing required to accommodate this bearing. The bearings are supplied to standard industry tolerances eliminating the necessity of an added sizing operation.

Tested over a 5-yr period, the new midget bearing gave top performance with no measurable depletion of the lubricant.

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### Oscillograph

A self-contained, single-channel, direct-writing oscillograph that weighs only 21 lb is available from Sanborn Co. in two models—Model 299 with general purpose d-c amplification, Model 301 with an a-c carrier amplifier. Both provide readout in clear inkless traces on rectangular-coordinate 40-division charts, and because of the extreme compactness, can be used as easily and frequently as any other bench-top test instrument.

The amplifier section of the Model 299 for recording d-c signals is a direct-coupled amplifier. The circuit is transistorized except for two vacuum tubes which are used for their high-input impedance characteristics. The resultant amplifier has extremely versatile d-c recording capabilities. Maximum sensitivity for the Model 299 is 10 millivolts per chart division and frequency response is d-c to 100 cps within 3 db at 10-division peak-to-peak amplitudes. The Model 299 has calibrated zero suppression. The Model 299A is without zero suppression.

The Model 301, for a-c recording of transducer output levels, contains an oscillator, high-gain carrier amplifier, and a phase-sensitive demodulator. All Model 301 circuitry is transistorized. The maximum sensitivity for this recorder is 10-microvolts rms per chart division and frequency response is d-c to 100 cps within 3 db at 10 divisions peak-to-peak.

Major specifications and operating features that are common to both models include switch-selected chart speeds of 5 and 50 mm per sec; paper loading from the top with 4 in. of visible chart; marginal marker stylus; monitor-output connectors that accept external scopes and meters; 40-division chart paper. Complete data for the Model 299 and Model 301 are available on request from Sanborn Co., Industrial Div., 175 Wyman St., Waltham 54, Mass.

### Safety Switches

Important design extras in a new 250-type ND safety switch include: Visible double-blade construction; positive, quick-make and quick-break operation; double insulation between blades and operating mechanism; optimum-size enclosures for maximum heat dissipation; plenty of wiring space for easier, faster installation; and an exclusive safety-yellow operating handle for quick "spotting" even in poor light.

The switch, developed by American Electric Switch Div., Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio, meets NEMA Standards for normal-duty industrial and commercial use and is approved by Underwriters' Laboratories for these applications as well as for service-entrance equipment. It is currently available in 30- and 60-amp, 250 and 600-volt ratings, both fusible and nonfusible.

Ventilating Fans
Roof Ventilators
...a galaxy of products to solve your air handling problems...
Industrial Fans
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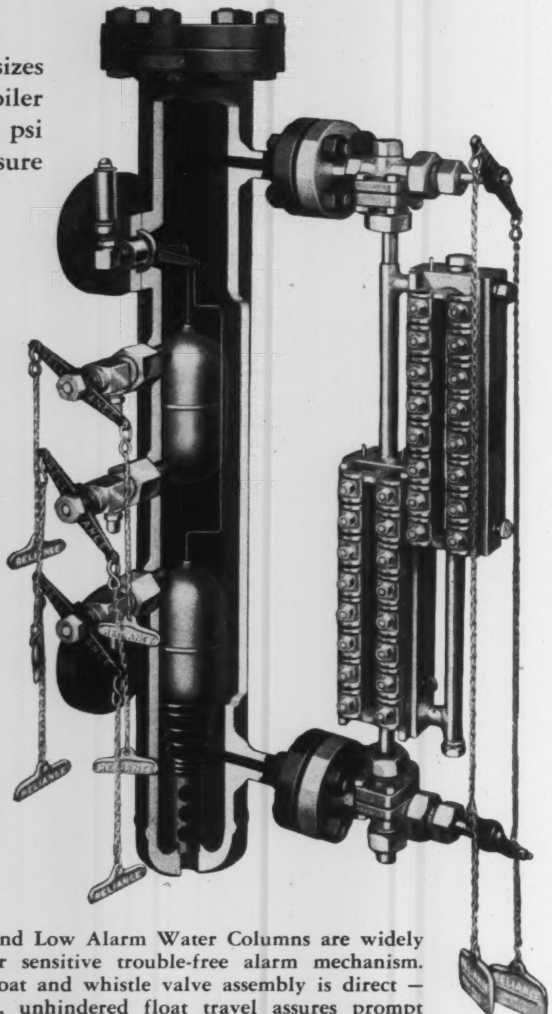
General Purpose Fans
THE NEW YORK BLOWER COMPANY
Sales offices: 3161 South Shields Avenue • Chicago 16

Insure safe, continuous boiler operation with

**Reliance**

Water Columns

Models and sizes for every boiler need to 2500 psi working pressure



Reliance High and Low Alarm Water Columns are widely known for their sensitive trouble-free alarm mechanism. Action of the float and whistle valve assembly is direct — foolproof. Short, unhindered float travel assures prompt response to slight water level variations. Reliance Alarm Columns, available to 900 psi, are completely assembled at factory and thoroughly tested before shipping . . . Above 900 psi, forged steel columns can be equipped to supply electric alarm service and other safety controls . . . Reliance also makes gage cocks, gage valves, gage inserts, illuminators and vision-focusing hoods in various styles to suit all needs. Engineer representatives in all principal cities.

**The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio**

Reliance BOILER SAFETY DEVICES

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### Toggle Switch

A series of 20-amp double-pole toggle switches with standard operating characteristics and basic dimensions has been introduced by McGill Mfg. Co.

Electrical ratings are: 20-amp, 125-volt, a-c $1^1/_2$-hp; 20-amp, 250-volt, a-c noninductive; 10-amp, 250-volt, a-c 2-hp. A choice of mounting arrangements, terminals, and circuitry makes the switch adaptable to a variety of industrial and consumer products. Furnished as standard for nipple mounting, flush or bent two-hole cover-plate models are available on order. Terminals come in either spade, screw, or solder type. Housing dimensions are 1.237 in. from front to end of spade, 1.2 in. long, and 0.762 in. wide.

The switches are made of durable materials. The housing is impact-resistant molded phenolic and the cover plate is cadmium-plated steel. Contact rivets are silver cadmium oxide inlaid on special copper-alloy material for strength. All connecting parts and terminals are silver-plated.

Choice of circuitry in the double-pole switches includes a single-throw; double-throw, center-off; double-throw, no-off; double-throw, momentary; single-throw, momentary; double-throw, one-side-on—one-side momentary, no-off; double-throw, one-side-on — one-side-momentary — center off. All models are Underwriter's Laboratories, Inc., inspected and CSA approved.

Further information available from the Electrical Div. McGill Mfg. Co. Valparaiso, Ind.

### Steam Traps

Tremendous savings can be effected by the use of the newly developed Type Velan TSV Piping King steam trap, developed by Valan Steam Specialties Inc., Beekman Rd., Plattsburgn, N. Y. where only two connections are required to make a complete steam-drainage installation.

The TSV consists of a forged-steel TS steam trap with integral strainer, check valve, and air vent welded to either one or two forged-steel gate valves. Both trap and valves are completely serviceable in the line in less time than it would take to remove a standard valve or trap.

A one-piece cage unit contains all steam-trap internal parts, and the removal of two stainless-steel screws permits the rapid replacement of every part except the body without touching a line connection.

The shut-off valves are a new patented bonnetless design with screwed-in seats of hardened stainless steel and a unique service cover containing the wedge guides. Through the service post, the seats, wedge, and stem can be removed and replaced in a matter of minutes.

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### Powerhouse Motors

A new line of powerhouse Life-Line A motors, from 40 to 250 hp in frames 364U through 506US, is offered by the Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

These powerhouse motors, designed as auxiliary units for generating stations, are furnished in three basic NEMA designs for a wide range of applications: Designs A and B (normal torque) for pumps, compressors, fans, blowers, etc.; Design C (high breakaway torque) for driving compressors without unloaders, loaded conveyers, certain coal pulverizers, and similar applications; Design D (for high-accelerating duty or high-inertia loads) for car dumpers, coal trippers, hoists, etc.

Specially designed end brackets provide maximum dripproof protection for the squirrel-cage units. The bearings are oil-lubricated sleeve bearings carefully grooved to give positive oil flow. Extra large oil rings provide more oil on the bearing surface. In addition, the large-capacity oil sump contains up to 70 per cent more oil than conventional units. An air-bypass is built into the bracket to prevent oil mist from being drawn into the motor by the blower.

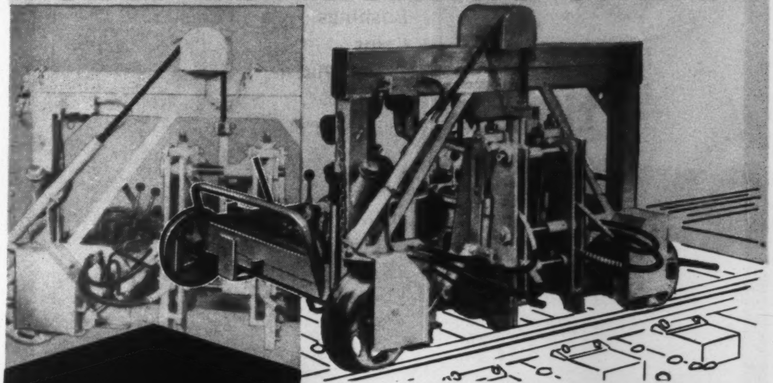
For longer motor life, Thermalastic insulation is used on the larger motors with form wound coils. Motors with random-wound coils contain powerhouse shielded insulation which gives maximum protection against exposure to high humidity, splashing liquids, and mild chemical concentrations. Where exceptional protection is required, Life-Guard insulation is available. Another option is the Guardistor system which offers a positive degree of winding overtemperature protection.

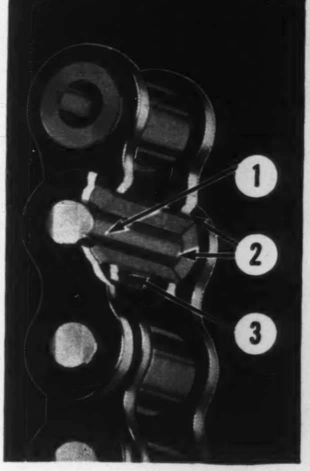
Other features of the powerhouse motors include: transparent inspection window for visual inspection of bearing and oil rings; sight oil gage for instant reading of oil-sump level; air-gap check holes in both brackets for easy checking of air-gap uniformity; oversize conduit boxes for ease in lead connections. Split sleeve bearings and brackets are also available.

### Lettering Pencil

The Mark V "fine-line" automatic-propelling lead pencil made by Alvin & Co. supplies an ever-pointed extra-thin lead, 0.031-in. thick for use with lettering guides or templates. It is 6 in. in length, weighs less than $^1/_2$ oz, and has a non-rolling hexagonal barrel with a knurled, tapered finger grip. Push-button-actuated fully automatic lead feed provides one-hand operation. Color-coded caps indicate degree of lead hardness. A special pocket model is only $5^1/_4$ in. long. For further information write to Alvin & Co., Windsor, Conn.

Another Tough Problem SOLVED BY WHITNEY MSL* SELF-LUBRICATING CHAIN





Resists SHOCK, STRESS, FATIGUE ON Railway Maintenance Machines

Raising and lowering a 550 lb. nipper assembly on the Racine Seco "Anchor-Fast" Rail Anchor Applicator approximately 18 times per minute puts severe shock, stress, and elongation loads on a chain.

Yet—the standard Whitney MSL Self-Lubricating Chain used on these hard-working track maintenance machines which apply rail anchors to the base of railroad rail to keep it from creeping lengthways, is providing superior performance month after month without a single instance of chain failure!

The chain replaced a steel cable which connected a hydraulic cylinder to the load. Through abuse in the field, the cable would develop kinks or twists that could not be removed, thus affecting the operation of the machine. Some excessive cable wear was experienced.

MSL Chain's built-in lubrication at the 3 critical wear areas provides great inherent strength and superior resistance to shock, stress, and fatigue. The chain remains flexible for life . . . does not bind or freeze . . . requires no maintenance, and provides up to 5 times longer service life than ordinary chain.

Built-in Lubrication at these 3 Critical Areas

Critical Area 1:

PIN—Protective oil film lubricates live bearing area between pin and bushing, minimizing wear by reducing metal-to-metal contact.

Critical Area 2:

PLATES—Oil-impregnated Sintered Steel Bushings extend beyond surface of inside plates to: act as lubricated thrust bearings, control clearance, and provide an oil cushion between plates, eliminating plate galling and seizing frequently caused by misalignment of sprockets.

Critical Area 3:

SPROCKET ENGAGEMENT—Oil film on MSL Bushing exterior provides constant lubrication between sprocket teeth and chain. Whitney MSL Chain requires no rollers, as the tough oil film on the bushing surface provides smooth sprocket engagement, cushions impact and reduces drive wear.

If the drive chain on your product must deliver optimum performance in severe operating environments, or operate with maximum cleanliness, check the advantages of Whitney MSL Self-Lubricating Chain. It is completely interchangeable with any similar pitch ASA standard chain. Write for MSL Chain Catalog today.

*MAXIMUM SERVICE LIFE

THE WHITNEY FB CHAIN COMPANY
a subsidiary of FOOTE BROS. GEAR AND MACHINE CORPORATION
4559 S. Western Blvd., Chicago 9, Ill.

POWER TRANSMISSION DRIVES

machine all these small parts from

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- Spindles
- Sprockets
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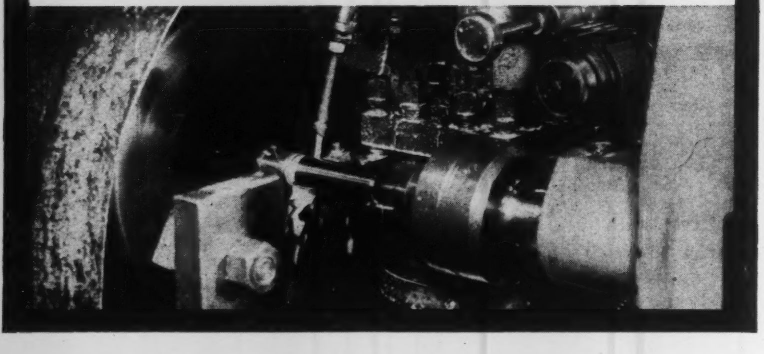
- Valve Guides
- Valve Parts
- Washers

6' SHENANGO IRON BARS



Now, many parts formerly cast to shape can be machined at lower cost from Shenango solid bars and centrifugally cast tubular bars.

Bars and tubes are available centerless ground for automatic screw machines or as cast for turret or engine lathe work. Expensive patterns are eliminated. Uniformity is guaranteed. Inventory is reduced. Production output is increased.

Write on your letterhead for a machining sample of Meehanite Metal, Ni-Resist or Ductile Iron. Centrifugally Cast Products Division, The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • MANGANESE AND ALUMINUM BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS • DUCTILE IRON

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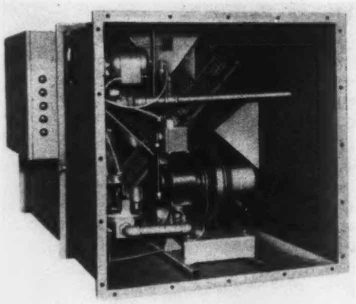


### Differential Speed Reducers

A new series has been added to the line of differential speed reducers made by Winsmith, Inc., 200 Eaton St., Springville, Erie Co., N. Y. Designated series HM, it offers seven horizontal motorized models—ratios from 1.1:1 to 50.000:1—0.12 to 81.51 hp—and a maximum output-torque range of 50 to 113,000 in-lb.

A unique unified planetary element automatically equalizes the load distribution through the planetary gears by means of a "floating" principle, provided by a cushion of oil between the planetary and internal-gear teeth. Regardless of gradual operating wear, it will automatically float into position and insure equalized load distribution, smoother operation, quiet running, and a longer service life.

Series HM will fit any standard C-flange motor and the over-all dimensions of the individual models never vary regardless of the reduction ratio. These horizontal motorized units require no bed plate, deliver more horsepower per pound of weight or cubic foot of space, and permit easier integration with the driven machine.

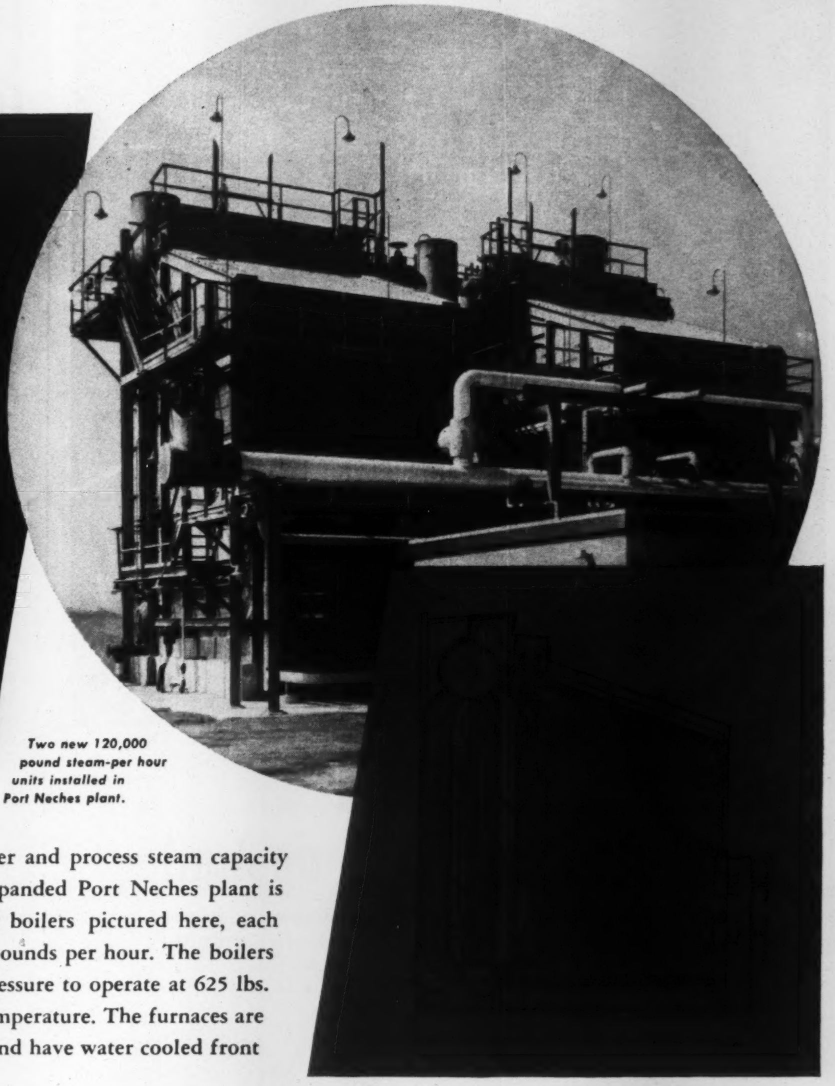
### Midget Transmissions

Oilgear Co. transmissions convert any constant-speed input power into an infinitely adjustable output speed. One or more adjustable speeds may be preset and selected in one or both directions up to 1650 rpm depending on the choice of integral control devices. Also, integral with these units is a gear pump for supercharge, control, and auxiliary service; a cooling fan; a fluid-reservoir case; and over-load relief valves. All working parts are pressure or flood-lubricated and totally enclosed for long-life protection.

Designed for applications of 1-hp or less, the units consume power only in proportion to work performed. There are no restricted-flow or directional-control valves used.

Address: 1560 West Pierce St., Milwaukee 4, Wis.

# Steam for Jefferson Chemical by Vogt



Two new 120,000 pound steam-per hour units installed in Port Neches plant.

The needed additional power and process steam capacity for Jefferson Chemical's expanded Port Neches plant is furnished by the two Vogt boilers pictured here, each with a capacity of 120,000 pounds per hour. The boilers are designed for 675 lbs. pressure to operate at 625 lbs. pressure and 769°F. total temperature. The furnaces are equipped with gas burners and have water cooled front and side walls.

Bulletins describing Vogt boiler installations in a variety of industrial plants for power, processing and heating are available on request.

*Installation by C. F. Braun and Co., Engineers.*

STEAM GENERATORS
Vogt
BOILERS
VF VS

*For Custom Installation Bulletin VF-VS-2 • Package Unit Bulletin PSG-3, address Dept. 24A-BM.*

HENRY VOGT MACHINE CO., LOUISVILLE, KENTUCKY

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Vogt
BOILERS

## STEAM GENERATORS

COOPERATION

produces the final design!

Cooperation is the key to any product. One man, perhaps you, has the responsibility for adding ideas and correlating the work of others to develop a superior design. Rockford Clutch has designed and supplied clutches for hundreds of products . . . let them help you. Their recommendations are without obligation and they are recognized leaders in the field of clutch design and manufacture. Whether it's a clutch for a motor truck, lift truck, bus, tractor, lathe or other equipment—call or write for recommendations on the Rockford Clutch to fill your needs.

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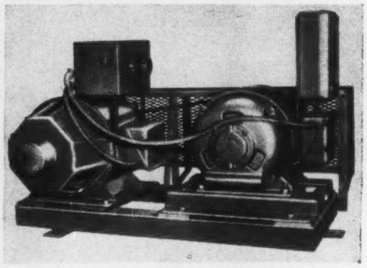
36 So. Wabash, Chicago, Ill.

## KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS



### Alternators

A new line of high-frequency motor alternators has been designed by Robbins & Myers, Inc., for economical high-cycle current beyond the practical range of frequency converters.

Although ratings and frequencies can be tailored to meet customers' requests, there are nine basic models in the line ranging from 1 to 7.5 kva and producing 360 to 3300 cps. Over-all dimensions are about 50 × 27 × 26 in. (max).

The alternator assembly features: (*a*) A high-frequency alternator, (*b*) a silicon-rectifier unit with time-delay fuses for field excitation, and (*c*) a Robbins & Myers drive motor, all on a heavy welded-steel base, with removable belt guard and sliding alternator base for easy belt adjustment.

Revolving-field construction is used in ratings of 1500 cps and lower, while a brushless inductor type is supplied for ratings over 1500 to accomodate higher operating speeds.

Without a regulator, voltage change will vary from no-load to full-load by 12 to 18 per cent depending on the rating involved. An automatic magnetic amplifier can be supplied to hold variation within 2 per cent if close regulation is required.

Sets are usually equipped with a pulley system matched to the desired output frequency, but in applications where a number of frequency changes are anticipated variable-pitch pulleys or variable-speed drives equipped with electric, hydraulic, pneumatic, or manual control can be furnished.

Additional information may be had from the Customer Service Dept., Industrial Motor Div. of the company, Springfield, Ohio.

### Ring Seals

A nonsplit, hydraulic and pneumatic linear-motion ring seal has been introduced by Gits Bros. Mfg. Co., 1866 S. Kilbourn Ave., Chicago 23, Ill. Its special, all-metal construction permits use at temperatures from −425 to +1500 F.

This Hi-Temp ring seal was developed to satisfy the increasing demand for high-temperature seals in hydraulic actuators, for high-temperature static-seal applications and for high-temperature swivel-joint seals.

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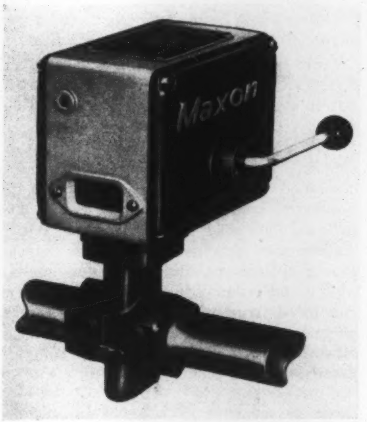
Designed as a unit, it comprises a metal lip of special design and configuration, fastened in a stainless-steel ring. The ring is specifically designed to support the lip in the axial direction and to prevent blowout under extreme pressures.

Under hydraulic pressures in excess of 20,000 psi, they show no leakage or other ill effects, and are compatible with practically all hydraulic fluids and gaseous media.

They are available in a standard 90 series and as a double unit in a 91 series (recommended in applications where pressure reversals in excess of 10 psi will occur).

Each series comes in 37 standard sizes, in bore diameters ranging from 1/2 to 7 in.



### Safety Shut-Off Valve

When connected with one or more safety circuit-breaking instruments and installed in gas or oil supply lines leading to the burners of industrial boilers, furnaces, ovens, kilns, and other processing equipment, the new Maxon Series 800 manual-reset valve shuts off flow of fuel automatically and instantly upon any break in the electric power of safety circuit.

Incorporating a body with unique "guillotine" action, the Series 800 safety valve assures tight closure. It is approved and listed by testing laboratories of Associated Factory Mutuals, Underwriters Laboratories, and Canadian Standards Association, and is regularly accepted and approved for industrial applications by Factory Insurance Association and other such regulatory bodies. Catalogs and engineering data sheets available from Maxon Premix Burner Co., 201 E. 18th St., Muncie, Ind.

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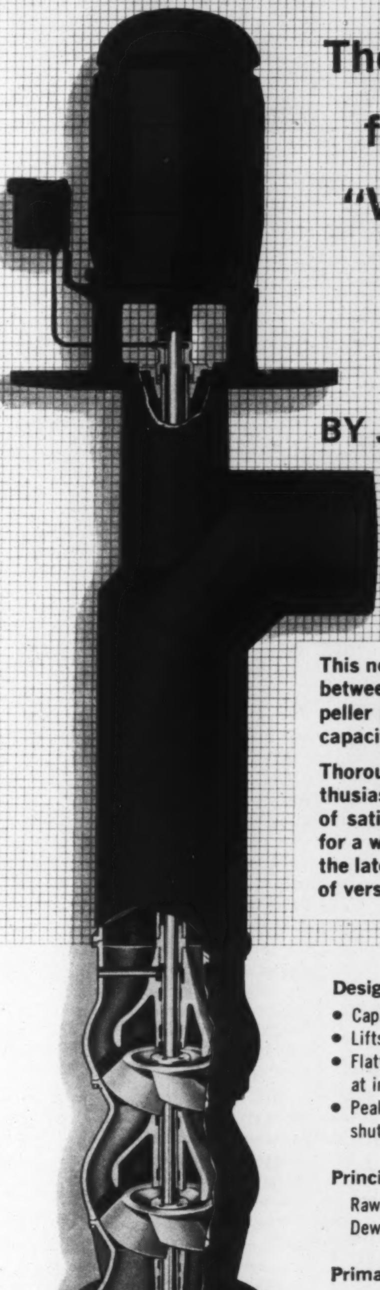

The pump that fills the "Vital Gap"

NEW MIXED-FLOW BY JOHNSTON

Large capacities at medium lifts

This new Johnston fills the "vital gap" between low head—large capacity propeller pumps and high head—smaller capacity regular turbines.

Thoroughly field-tested and already enthusiastically recommended by a score of satisfied users, it is now available for a wide range of applications and is the latest addition to the Johnston line of versatile vertical pumps.

**Design Features:**

- Capacities exceeding 100,000 gpm.
- Lifts from 20 to 60 feet.
- Flatter hp curve means less overload at increased heads.
- Peak performance at 40 to 60% of shut-off head.

**Principal Applications:**

Raw water intake; Low lift transfer; Dewatering; Spray pools; Sewage effluents.

**Primary Users:**

Power plants; Sewage treatment installations; Flood control; Land reclamation; Steel mills, refineries, chemical plants, etc.

For complete details and specifications, call or write your nearest Johnston distributor or contact the factory direct.

JOHNSTON PUMP COMPANY
A DIVISION OF THE YOUNGSTOWN SHEET AND TUBE COMPANY
3272 East Foothill Boulevard, Pasadena, Calif.
**Branch Warehouses:** Roswell, N. M.; Hastings, Neb.; Pecos, Texas; Idaho Falls, Idaho

# DO YOU HAVE A NEW PRODUCT IDEA ?

Large, well-capitalized manufacturer with extensive product development and marketing facilities is anxious to screen ideas and inventions of new items which would have volume application in industry, commercial establishments or homes. Need for practicality suggests that ideas come mainly from persons of engineering or technical background. Full legal protection. In first communication, describe the nature of the product and its specific applications, and indicate the present stage of its development. Request forms for formal detailed submission and acknowledgment.

**Write Box PME-700**
**care of "Mechanical Engineering."**

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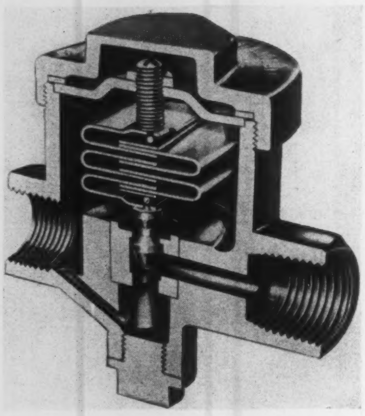

## Thermostatic Steam Traps

A new line of low-cost, thermostatic steam traps is available from the MIL Div. of Farris Engineering Corp., 612 Commercial Ave., Palisades Park, N. J. It includes high and low-pressure types in pressure-balanced thermostatic and float-thermostatic designs.

Unaffected by pressure, water hammer, frost corrosion, or rough handling, their operation is maintained by a patented, indestructible, stainless-steel, bimetal thermal element with universal joints which responds only to temperature and has proved more reliable than bellows and diaphragm types.

Maximum resistance to corrosion and metal fatigue is accomplished by use of forged aluminum-bronze for the bodies and stainless steel for all working parts. Simple design and precise manufacturing control assure minimum steam loss and trouble-free operation in a wide range of applications including superheat service to 500 F.

MIL steam traps are used on heat exchangers, instantaneous heaters, stills, steam radiators, sterilizers, tanks (coil-heated), vulcanizing presses, hot plates, drying coils, relay points, terminal ends, and branch mains.

There is a variety of body styles, connections, and strainers. Pressure ranges are vacuum to 25 psi, vacuum to 65 psi, vacuum to 125 psi, 0 to 225 psi, 0 to 300 psi. Pressure ranges for float-thermostatic types are 0 to 75 psi and 0 to 150 psi.

## Cooling Tower

The capacity of the double-flow Aquatower line of cooling towers has been expanded to meet the water-cooling requirements of major air-conditioning and industrial-process cooling applications. A new Series 15 tower bridges the capacity gap between the standard line of double-flow Aquatowers and unlimited-capacity industrial cooling towers made by the Marley Co., 222 West Gregory, Kansas City 14, Mo.

It combines many of the proved features of both double-flow Aquatowers and Marley industrial cross-flow towers. Industrial-tower features are: sloping louver walls and broad louvers, introduced and patented by Marley in 1957, and glass-reinforced polyester-filling supports for permanent alignment and positioning of splash bars.

From the basic double-flow design the Series 15 utilizes open-gravity water-distribution system, minimum height in relation to capacity, low pumping head, safe inspection and maintenance. New components, supplied as standard equipment include: combined mechanical-equipment support and hot-water lateral, flow-control valves and external lube lines on gear drives. Water-distribution arrangement permits several piping options including concealed internal piping and either sidewall or endwall risers. Advanced structural arrangement is said to effect appreciable reduction in erection costs. Bulletin DFA15-60 is available for complete details.

## High-Voltage Switch

A compact high-voltage switch (100,000 volts, 1 amp) especially designed for distributing power from rectifiers to the electrodes of electrostatic precipitators but usable with other types of high-voltage low-current equipment is announced by Buell Engineering Co., 123 William St., New York, N. Y.

The switch is a multideck rotary type designed to operate in all types of insulating oils. When housed in its own compartment, it occupies about 1 cu yd, approximately $^{1}/_{4}$ of the space required by an equivalent air switch. It may also be immersed in the same compartment as the transformer-rectifier by lengthening or widening the compartment approximately 2 ft.

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Defense #1
HEART FUND

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BUSINESS NOTES
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LATEST CATALOGS

### Check Valve

A bronze lift ball check valve has been added to the Fairbanks line of bronze and iron body valves.

The new ball check valve carries pressure ratings of 200-psi steam working pressure at 550 F; 400-psi cold-water, oil, or gas pressure —nonshock— and it is available in sizes $^{1}/_{4}$ through 1 in. The ball for the valve is of stainless steel and the port opening and lift space for the ball is designed to provide "full port" opening.

The ball-type lift check valve is particularly recommended for service on viscous-fluid lines although it is also used to prevent return flow on steam, water, oil, and gas lines. The ball-type lift check valve will close faster against back pressure than lift check valves with other types of disks. Greater freedom of action of the ball, as compared with the guided action of the disks in other types of lift check valves, gives the ball-type check valve a decided advantage in speed of closing, especially on viscous-fluid lines. The ball check valves must be installed in the upright position on horizontal lines only. Further information available from the Fairbanks Co., 393 Lafayette St., New York 3, N. Y.

### Weatherproof Motor

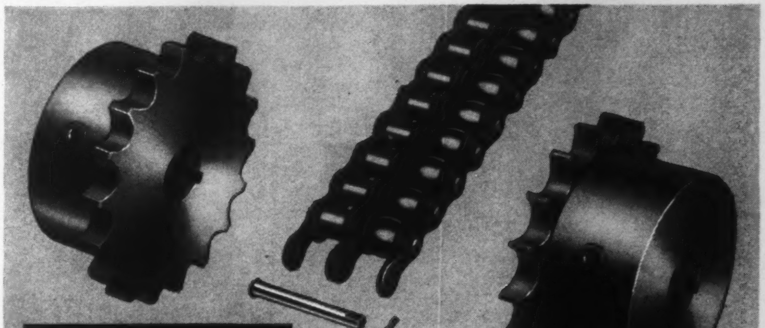
A completely new line of open weatherproof a-c motors with an epoxy encapsulated insulation system has been introduced by Reliance Electric and Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio. Called Duty Master Weatherproof Motors, they are currently available in frames 180 through 445U (1 through 125 hp) in all standard speeds and voltages.

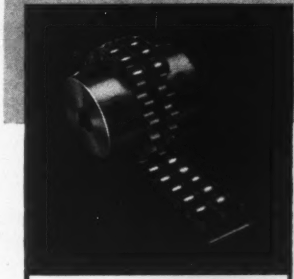
The stator windings are thoroughly encapsulated in a specially formulated epoxy resin for resistance to moisture, oils, dust, chemicals, acids, and alkalies. The bearings, exposed internal metal surfaces, hardware, and mechanical parts are also protected against damage from the elements and contaminating atmospheres in all types of indoor and outdoor applications.

### High-Pressure Strainer

A high-pressure strainer for up to 5000 psi, designed with $^{1}/_{4}$-in. NPS male-inlet and $^{1}/_{4}$-in. NPS female-outlet connections is announced by Spraying Systems Co., Bellwood, Ill. It is made of stainless steel with choice of 50, 100, or 200-mesh screens. The strainer screen assembly is specially designed to resist all line pressure and conditions; under test, the screen will not collapse even when completely clogged. Typical applications for this high-pressure strainer include use with airless paint-spray guns such as the company's GunJet 22 Model H hand spray gun or the AutoJet automatic gun, or any other high-pressure $^{1}/_{4}$-in. NPS line application.

ACME
FLEXIBLE COUPLINGS
CAN BE INSTALLED IN MINUTES





★ Compact
★ Economical
★ Higher H.P. Per Given Diameter
★ Minimum Backlash
★ Constant Power Transmission
★ Positive — Yet Flexible
★ Maximum Flexibility
★ Rugged
★ Durable

**This is the easiest trouble-free coupling you can install on your equipment. ACME Flexible Couplings are quickly assembled or dis-assembled by means of a chain that has only one pin to connect or remove. Connecting links are permanently positioned on chain to engage connecting pin without difficulty in assembly. Positive Power Transmission is assured, with provisions for both angular and parallel misalignment. They absorb shock loads, provide maximum flexibility with minimum backlash. All heat treated steel construction to give maximum life expectancy. You save money in the long run.**

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HOLYOKE MASSACHUSETTS

COMPLETE LINE OF ROLLER CHAINS AND SPROCKETS • DOUBLE PITCH CONVEYOR CHAINS • STAINLESS STEEL CHAINS • CABLE CHAINS • FLEXIBLE COUPLINGS • STANDARD AND SPECIAL ATTACHMENTS

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BUSINESS NOTES
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LATEST CATALOGS

### Radiant-Heat Panel

Radiant-heat panels for commercial and industrial applications have been introduced by the Infrared Div. of Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.

Designated Chromalox Type QRP, the panels are equipped with quartz-tube elements. The series is designed to provide excellent terminal and resistor life and to obtain maximum serviceability from the quartz heat source.

Uses include paint baking, industrial process heating, railroad-car thawing, marquee heating, and indoor and outdoor spot comfort heating.

The 1 × 4-ft panels in 4 and 6 kw are available for 208 and 240 volts, while the 240-volt elements may be connected in series for operation on 480 volts.

Where large areas of radiation are involved, Type QRP panels may be mounted horizontally at any angle, end to end, and edge to edge on $^1/_2$-in. conduit stems. Also, on metal framework using $^1/_4$-in. bolts for which spot-weld nuts are provided on the back of each panel. Single-end wiring by user is facilitated by built-in wiring gutter.

For maximum effective radiation, each panel is equipped with a bright nickel-plated steel grille with reflecting ability in excess of 80 per cent. Heat loss through the panel is inhibited by insulation between reflector and panel back.

To make mounting and interconnecting easy, ten $^1/_2$-in. conduit knockouts are provided in each panel.

### Dust Collectors

A newly developed, highly efficient, automatic filter shaker is now available on all models of cloth-filter-type dust collectors, made by Torit Mfg. Co., 1133 Rankin St., St. Paul 16, Minn.

Peak operating efficiency is assured by thoroughly shaking the filters each time the dust collector is used, eliminating reliance on human memory.

The automatic shaker is powered by an independent electric motor mounted on the side of the collector. When the shaker bar is oscillated horizontally, its metal fins strike each cloth filter bag to free the dust particles and cause them to drop into the dust tray.

Shaking action begins automatically whenever the collector motor is turned off. After shaking the filters for 2 min, the mechanism shuts itself off and will not operate again until the collector has been turned on and off again.

Available with single-phase, 110 or 220-volt, 60-cps motors, the shaker can be used regardless of the voltage of the collector.

# KEEP INFORMED

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## Plastic Netting and Piping

Two new forms of thermoplastic materials, Vexar plastic netting and piping are manufactured by an exclusive process that extrudes polymers directly in tubular net form through a single operation. By this technique, each strand intersection becomes an integral part of the material, even stronger than the individual strands—in contrast to die-cut, interwoven, or heat-sealed netting or tubing where the openwork pattern is made after the material is extruded.

Du Pont acquired U. S. rights to the patented British development last year. Although still under development, commercial quantities of Vexar made of polyethylene are nowavailable.

An almost infinite variety in mesh size and pattern, filament diameter, strength, stiffness, and color is possible. In addition, the products retain the chemical and physical characteristics of the basic plastic resin. Thus the initial polyethylene versions of Vexar have the chemical inertness, flexibility, and resistance to moisture, rot, and mildew characteristic of polyethylene.

Strand diameters can be made from 15 mils up. Mesh size can be varied from 16 counts to the inch—smaller than normal window screening—to more than an inch between strands, somewhat similar to the spacing in large fish net or diamond-weave heavy-wire fencing.

Three basic patterns are available: Diamond, where intersecting strands are on the bias to the direction of extrusion; twill, in which one strand parallels the extrusion direction while the other is on the bias; and plaid, a decorative version of the diamond pattern, in which strands are grouped and spaced unevenly to provide a wide variety of effects.

Semi-rigid Vexar piping, in a variety of colors, is finding use as a protective sleeve over highly polished tubular machine parts, such as bearing shafts. The slight elasticity of the tubes allows a major simplification in inventory problems. Where a manufacturer might maintain a stock of several hundred different diameters in paper tubes to protect polished finishes on shafts, it could substitute three sizes of the new piping.

E. I. du Pont de Nemours & Co., Wilmington, Del.

## Ductile Iron Pumps

A complete series of single and multistage horizontal pumps cast in ductile iron has been placed on the market by Peerless Pump.

Described as pumps with extreme thermal-shock and corrosion resistance, the two pump series, designated as Type A and Type TU and TUT, are for intermediate-range service. Both series have a fluid-temperature range of 350F.

Type A pump is a continuous-duty, horizontal split-case, single-stage centrifugal pump. It can be applied to the widest variety of pumping jobs handling water and other liquids, even when there is a modest amount of nonabrasive solids in suspension. It is available in sizes of 4 in. and larger; capacities to 60,000 gpm; heads to 400 ft. All types of drives are available for this pump.

Type TU and TUT is a horizontal, split-case, multistage pump. It is available in two-stage (Type TU) and three, four, or five stage (Type TUT) design. This series of pumps is ideal for supplying, circulating, and boosting water and process liquids. Heads up to 1500 ft and capacities of up to 3000 gpm are readily handled by this pump group. All types of drives may be used.

The use of ductile-iron cases, according to the manufacturer, commends these pumps for many operations in refining and process industries. Ductile iron compares favorably with carbon steel in strength—plus having the equally desirable thermal-shock-resistant qualities. During extensive testing, ductile-iron cases were heated to temperatures in excess of 1350 F, then subjected to sudden cold-water quenching.

Write Peerless Pump, Hydrodynamics Div., Food Machinery and Chemical Corp., 2005 Northwestern Ave., Indianapolis, Ind., for Bulletin B-1314.

# BUSINESS NOTES

## Purchased

Yuba Consolidated Industries, Inc., has purchased the K. W. Anderson Co. of Tulsa, Okla., manufactureres of high-temperature furnaces for processing industries. The Anderson Co. is being consolidated with the Petro-Chem Development Div. of Yuba because their products and markets are compatible.

Sales activities of the combined organizations will headquarter out of Tulsa, Okla. Due to order backlogs, Petro-Chem Development Div. for the time being will maintain design, engineering, and manufacturing activities in both its Houston, Tex., plant and the Anderson facility in Tulsa.

The company said that Yuba is now in a position to offer its customers both the Anderson horizontal Uni-Rad furnace and the Petro-Chem vertical Isoflow furnace, both types being used by the petroleum, chemical, petro-chemical, and pulp and paper industries.

2 STAGE CONTROL OPERATION

1 MERCOID PRESSURE CONTROL

MERCOID CONTROL

**MERCOID DA-400 SERIES**
**Pressure Controls are dual purpose controls, incorporating a single pressure element operating two separate, independently adjustable Mercoid magnetic switches. The switches may be used for multiple circuit control for various operations as the control responds to pressure changes.**

For example:

- Close one alarm circuit at high pressure and another at low pressure with both circuits open over operating range.
- As an electrical interlock to open one circuit as pressure rises above and the second circuit as the pressure drops below operating range.
- To provide two-stage control by opening or closing one circuit on a rise in pressure and the second circuit on a further rise in pressure.

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17 PRESSURE RANGES
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TO 300-2500 PSI.

Available in three case styles:
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Weather-Proof (NEMA 1A, 2, 3, 4)
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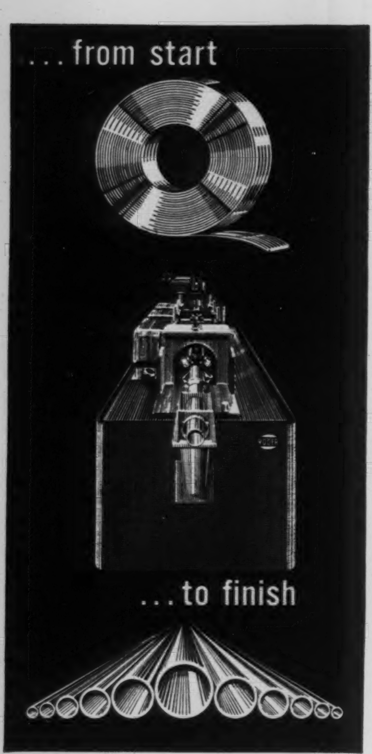
WRITE FOR BULLETIN NO. 11

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.



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If your products require pipe or tubing from 3/16" to 26" diameters, Yoder Pipe or Tube Mills and accessory equipment can help you produce your product more efficiently to meet today's competitive markets.

In addition to Pipe or Tube Mills, Yoder engineers and builds a complete line of Slitting equipment and Cold Roll-Forming Machinery.

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BUSINESS NOTES
LATEST CATALOGS

## Company Services

"The 8 *plus* values that back up U. S. Motors" is the topic of a brochure released by U. S. Electrical Motors Inc., Milford, Conn., which describes the company's major plants and facilities, sales and service offices, warehouses and other company services.

## New Headquarters Building

A new headquarters building for the Raytheon Co., Electronic Services Div. has been opened at Burlington, Mass. Control center for some 300 globe-trotting field engineers engaged in product support for both government and commercial customers, the 27,000-sq-ft, one-story structure is completely air-conditioned.

It houses administrative areas, lecture and laboratory areas for training in maintenance of electronic equipment, a technical library, publications and storage areas, and a cafeteria.

The new Burlington building, Raytheon's second in that community, houses some 150 administrative, marketing, and training personnel formerly in facilities at Waltham, Maynard, North Dighton, and Wayland.

# LATEST CATALOGS

## Accumulators

Newly issued four-page folder provides dimensions and other specifications on three sizes of Hydra-ride accumulators to cushion lift-truck loads, lessening danger of spillage and breakage, reducing damage to lift mechanism, diminishing risks due to driver fatigue, and increasing material-handling efficiency. Folder includes installation information. Request Hyrda-ride Bulletin 1630B2 from Parker Hydraulics Div., Parker-Hannifin Corp., 17325 Euclid Ave., Cleveland 12, Ohio.

## Belt-Conveyer Idler

The Joy Series 200 Limberoller belt-conveyer idler, an improved version of the original two-bearing catenary idler introduced by Joy Mfg. Co., Pittsburgh 22, Pa., in 1953, is described in a new 20-page bulletin, LD-111.

The Limberoller idler consists of a series of neoprene disks molded to a neoprene-covered, flexible steel-wire cable suspended from two endmounted bearings. On the new model, according to the manufacturer, cable strain is reduced by free-swiveling bearing mounts and extra reinforcement between end disks.

## Motor Application Guide

The Century Electric Co., 1806 Pine St., St. Louis, Mo., has issued a new 1960 Motor Application Guide, a 16-page bulletin No. 270B, which outlines motor characteristics and designs.

## Thermocouples

Catalog G100-4 outlines Honeywell's new MegopaK line of hard-pack, small-diameter, mineral-insulated thermocouples. Specifications, ordering information, and prices on MegopaK bulk material, elements, and complete assemblies are included. The catalog is available from Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

## Welding Equipment

The new Sigmatic line of welding machines, plus torches and controls, for consumable electrode, inert-gas-shielded welding are described in a 16-page Sigmatic manual welding equipment catalog, F-1393, is available from Linde Co., Div. Union Carbide Corp., 270 Park Ave., New York 17, N. Y.

The three popular styles of standard-component Mig welding machines in the Sigmatic line—frame, sled, and cart-type units—are covered. Torches for continuous-fusion welding (spray-arc or Short-Arc) and spot welding are described, along with a complete line of welding controls.

## V-Belt and Industrial Hose

A comprehensive catalog covering its line of industrial V-belts, including Cog-Belt and Poly-V and fractional-horsepower types, as well as sheaves and industrial hose, has been issued by Dayton Industrial Products Co., 2001 Janice Ave., Melrose Park, Ill.

The 52-page catalog No. 260 lists the complete Dayton Product line with data on sizes, dimensions, and prices and is punched for notebook insertion. It is available from Dayton Industrial Products Co., 2001 Janice Ave., Melrose Park, Ill.

## Valves

A 28-page catalog No. FE-138, issued by Farris Engineering Corp., 612 Commercial Ave., Palisades Park, N. J., describes the complete Farris line of safety-relief valves for marine service, fire-pump service, hydraulic pressure systems, liquified gases, chemical corrosive service, and general industrial service.

A new series of low-cost, compact, safety-relief valves is cataloged for the first time. Useful sizing information, capacity tables, weights and dimensions, and application data are arranged in a new format which greatly simplifies valve selection.

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BUSINESS NOTES
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LATEST CATALOGS

### Instrument-Range Changing

A four-page Data Sheet NY2(1) "Speedomax H Range Conversion," available from Leeds & Northrup Co., Philadelphia 44, Pa., provides a guide to selecting the necessary components—scale, chart, circuit panel, and so forth—to change the range of any standard Speedomax H instrument.

### Ball Bearings

New concepts for applying thin-sectioned large-bore ball bearings to equipment designs are presented in a 28-page engineering Bulletin S-112R available from Kaydon Engineering Corp., Muskegon, Mich.

Applications shown range from wire-twisting machines to paper-making machine press rolls, and from heavy-duty lathes to submarine periscopes.

### Reversible Turbine

Bulletin 2000 describes the Type GET reversible turbine, designed for 1 to 45 hp with 1000-psig maximum inlet pressure. Type GET can also be supplied with one set of blades for nonreversible operation, and is adaptable for steam, Freon, and other gases. Write Dean Hill Corp., 4000 E. 16th St., Indianapolis 7, Ind.

### Digital Information System

Operation of Metrotype digital information system using all solid-state components is described and illustrated in new eight-page Bulletin E72-2, available from Bailey Meter Co., 1026 Ivanhoe Rd., Cleveland 10, Ohio. Complete specifications are listed along with a variety of readout devices.

### Variable-Speed Sheave

T. B. Wood's Sons Co., Chambersburg, Pa., has revised Bulletin 6102 to provide additional technical data and new list prices on the SVS variable-speed sheave. This multiple-groove V-belt sheave is adjusted to desired pitch diameter by turning an adjusting screw. Accurate continuous speed control is provided without sticking or freezing.

### Plug-In Bus Duct

Application data for plug-in bus duct is contained in a new 28-page booklet available from the Westinghouse Electric Corp. containing descriptions, drawings, dimensions, specifications, engineering and test data needed to lay out, specify, and install this type of bus duct.

For a copy of application data number 30-661, write to the company at P.O. Box 2099, Pittsburgh 30, Pa.

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BUSINESS NOTES
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### Steel Tubing

A four-page technical bulletin, containing a quick-reference weight chart for square and rectangular welded-steel tubing is available from Standard Tube Co., 24400 Plymouth Rd., Detroit 39, Mich.

In addition there is a comprehensive listing of square and rectangular welded-tubing tolerances for twist, straightness, cutting length, corner radii, and diagonal dimensions.

### Vibration-Control Specifications

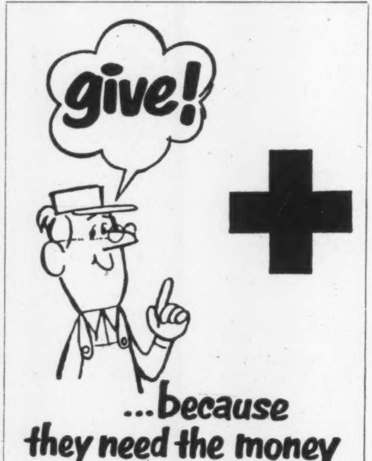
A complete guide to writing vibration and noise-control specifications for air-conditioning and related equipment is available from the Korfund Co., 48-23y 32nd Place, Long Island City 1, N. Y.

Designated Bulletin F2D, this 6-page guide simplifies the engineer's or contractor's job of writing complete, correct vibration and noise-control specifications for all types of air-conditioning and related equipment. It discusses the factors involved in the selection of the various resilient mountings commercially available, with particular attention to the effects of existing job conditions, specifically extremely critical, critical, and noncritical conditions.

### Rex-Syn Packings

Cup packings made of Rex-Syn, a combination of a plastic resin and an elastomer, are described in a four-page folder available from E. F. Houghton & Co., 303 West Lehigh Ave., Philadelphia 33, Pa.

Rex-Syn is a firm yet low friction, multipurpose material that stands up remarkably well, the company states, even in unusually punishing hydraulic and pneumatic applications.



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### Sludge Removal

A new 12-page bulletin, No. 315-81, on the Rex Unitube Tow-Bro sludge remover for industrial and municipal use has been announced by the process-equipment div., Chain Belt Co., Milwaukee 1, Wis.

Savings of 20 per cent or more in equipment costs are claimed as compared to the previous nozzle and arm design as well as the most rapid sludge removal of any type of removal mechanism. Adaptable to any size or type of tank for uniform and positive performance it can be combined with the Rim-Flo for prompt settling and removal of light sludges, and Rex reciprocating Tow-Bro for long and narrow rectangular tanks.

### Control Valves

Concise and up-to-date information on the Conoflow Series LB control valve, is given in Data Sheet No. 101 which shows features of construction, optional accessories, and complete specifications. The LB is a single-seated, split-body valve with a powerful pneumatic-cylinder actuator and built in positioner. Tight shutoff is guaranteed in all sizes, $^3/_4$ through 6-in. regardless of operating variables. Write Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.

### Electric Fork Truck

A four-page bulletin, illustrating and describing its 2000-lb-capacity, electric-powered fork truck, has been published by Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland, Ohio.

The new truck, designated as Model F-48T2, is specifically designed for use in such low head room areas as covered street trucks, in tunnels, in basements, or in areas where overhead pipes, machinery and like obstructions exist.

### Machining of Teflon

"Basics in the machining of Teflon" is the title of a 12-page booklet just released by the Plastic Products Div. of Raybestos-Manhattan, Inc., Manheim, Pa.

It contains suggestions for stress relieving; the tools and coolants to use; speeds and rates of feed; rakes, angles, and clearances; burrs and chips; turning, boring, drilling, tapping, reaming, counterboring, grinding; fly-cutting; surface finishes; tolerances, etc.

### Fluid Drives

A 20-page bulletin, A-719, describing the Class-4 line of adjustable-speed Gyrol fluid drives is available from American-Standard Industrial Div., Detroit 32, Mich. The advantages of adjustable-speed fluid-drive are shown with horsepower and inertia starting-capacity curves.

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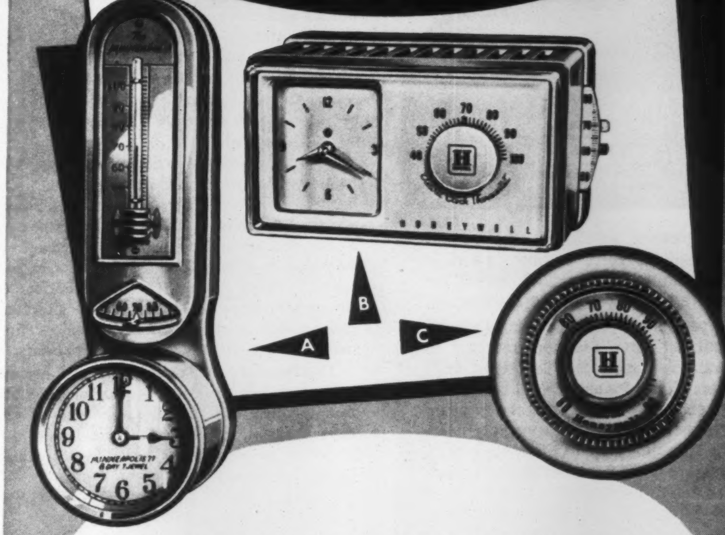
in its 75th year



**A small company used its first thermostat as a part of the "damper flapper"—a control unit which operated the damper on a coal fired furnace. Thus, automatic heating was born in 1885.**

**The company became known as Minneapolis-Honeywell and for 75 years has been recognized as a leader in the development of thermostats and heating controls. The famous clock thermostat ("A" above) appeared in 1906. It featured a big, brassy, eight-day clock. A far cry from this original masterpiece is Minneapolis-Honeywell's modern, precision built and attractive electric clock thermostat ("B" above). This newest clock thermostat automatically adjusts room temperature to the living schedule—constant warm temperature by day, cooler room temperature by night.**

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**We, at Chace, are proud that we have been contributors over the years to the success of such a great company.**

**Happy 75th anniversary, Minneapolis-Honeywell!**

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**In perfecting modern de-icing equipment, air force designers received an invaluable assist from Cash-Acme engineers. Since ordinary valves and liquids are completely inoperative at 65° below zero, new methods were urgently needed. With the help of Cash-Acme Back Pressure Valve (Type FR) specially modified for this extremely rigorous job—a unique sprayer was developed for discharging ethylene glycol.**

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**6627 East Wabash Ave., Decatur, Ill.**

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## Reset Timer

Plug-In Bulletin 125 Cycl-Flex reset timer for industrial time-control is furnished by Eagle Signal Co. complete with its own plug-in case permanently mounted and wired to the application. It can be flush mounted by cutting one $3^{1}/_{8}$-in-diam opening. All terminals and wiring information are conveniently located on the rear of the timer case. The timer itself may be removed and replaced from the permanently mounted case at any time in 5 sec or less. The handle also serves as a lock to insure a positive dust and oil-resistent seal.

Four separate and independent load contacts, two of which are instantaneous, may be used as relays in circuitry. Two others are time-delay relay contacts which operate at the end of the time set on the attractive, easy-to-set, easy-to-read dial. Each load contact, being separate and independent of the other, provides hundreds of practical control combinations, in many instances eliminating other costly circuitry components.

The two time-dealy relay contacts feature built-in adjustment to provide for an additional timed differential at the end of the time interval, as needed. This timed differential, or momentary pulse, is adjustable up to $1^{1}/_{2}$ per cent of the total cycle.

Further information available from the company at 202 20th St., Moline, Ill.

## Boiler Control

Boiler control on the all-outdoors 850-psig, 900-F Unit 7 at the Municipal Lighting Plant in Taunton, Mass., is described in the 12-page Bulletin 1065 published by Copes-Vulcan Div., Blaw-Knox Co., Erie 4, Pa. A comprehensive schematic diagram shows the simplicity of control circuits comprising the system engineered for the 145,000-lb per hr boiler fired with Bunker-C oil and having provision for future use of pulverized coal or natural gas.

## Socket Cap Screws

Complete specifications for Bristol's new 1960 series socket cap screws are given in Bulletin 773. It includes tables giving dimensional standards, concentricity limits, and threading dimensions for the 1960 series. A table comparing dimensions of 1960 series and 1936 series screws and a table giving dimensions of 1936 series screws are also included.

The bulletin is available from The Bristol Co., Waterbury 20, Conn.

## Cryogenic Gas Data

Latest data on the physical properties of cryogenic gases is available in both wallet-size and full-sheet-size cards from Air Products, Inc., Allentown, Pa. The information supplied includes boiling points, critical points, triple points, specific heats, and densities of most gases ranging from acetylene to xenon. Data on nitrogen trifluoride is supplied for the first time.

## Liquid-Feed System Control

Proportioneers Treet-O-Control a method of combining fluid meters and proportioning pumps by synchronization and control of a continuous process from a single source, manufactured by B-I-F Industries, are described in a four-page bulletin, Ref. No. 1400,20-1.

Uses in treating, sampling and diluting are explained, as well as operation and flexibility of application. Engineering data include sizes and capacities of Treet-O-Units, dimensions, air operating pressures, impulse-motor air consumption, control-line air consumption, and control-line sizes. Write to the company at P. O. Box 1342, Providence 1, R. I.

*Definitions of Occupational Specialties in Engineering*

**This book contains comprehensive data related to all activities and specializations in engineering including specific knowledge and duties, responsibilities and related techniques necessary for successful performance in each field.**

**The ten activity fields defined are research, design, development, testing, procurement, production, construction, operation, administration, and teaching.**

**Major engineering fields of specialization defined include aeronautical, automotive, ceramic, chemical, civil, electric and electronics, guided missiles management, marine, materials, mechanical, metallurgical, mining, naval, nuclear reactor, ordnance and armament, petroleum and fuels and power plant engineering. Other engineering fields defined are: packaging, photogrammetry, agriculture, geology, and geophysics.**

**Pub. 1952 Price: $2.50, 20% less to ASME members.**

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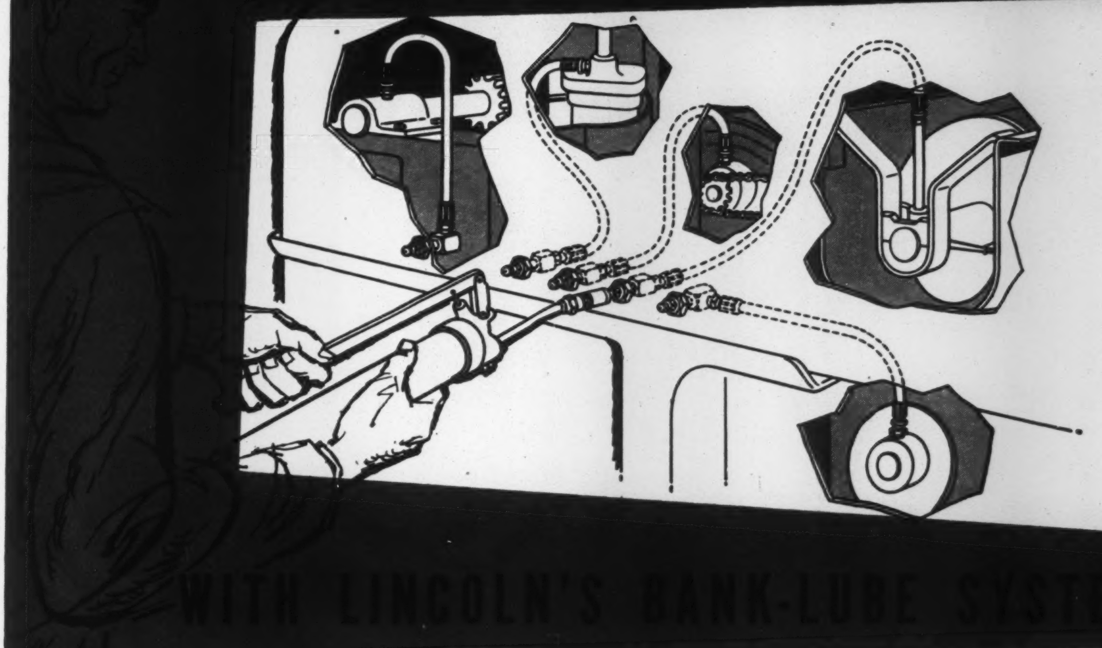

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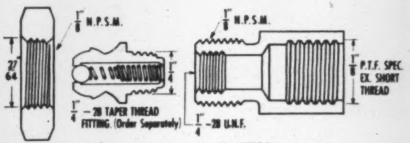

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## NEW EQUIPMENT
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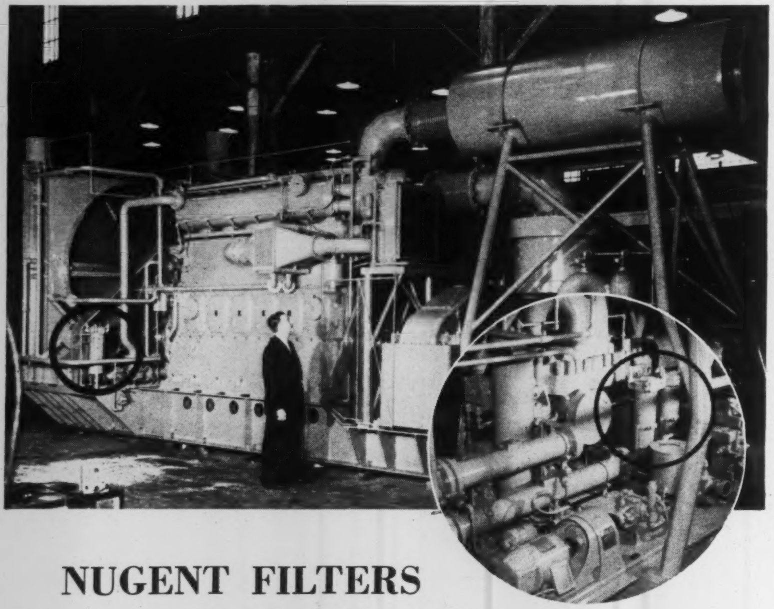
### Temperature Controllers

A four-page brochure is available from Fenwal Inc., Pleasant St., Ashland, Mass., on electronic, indicating, temperature controllers, Series 560. A thermistor is the temperature-sensing element, and the three major modes of indicating control—On-Off, proportional control, and adjustable differential—are all combined and available at the flip of a switch. Instruments cover the range of −100 to +600 F. Write for brochure MC-185A.



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in Sheikdom of Kuwait

Nugent lube and fuel oil filters provide maximum filtering protection for this skid-mounted pump package. One Nugent 1555-4S laminated fiber disc filter handles the lube oil for the 1000 HP Enterprise Diesel Engine powering the crude oil pump. Two 1555-4S units operating in parallel filter the heavy crude fuel oil consumed by the engine. The equipment is now in service in the Sheikdom of Kuwait on the Persian Gulf.

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OIL FILTERS • STRAINERS • TELESCOPIC OILERS
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### Electron-Beam Welding

Electron-beam welding is described in a 12-page Form ADC 937, issued by Air Reduction Sales Co., Special Products Dept., 150 E. 42nd St., New York N. Y. This method, which welds by the direct bombardment of metal with highly accelerated electrons in a vacuum chamber, has special significance in regard to the newer metals and alloys which are difficult or impossible to weld with conventional techniques.

### Transducer Products

Pressure instrumentation, force-balance instruments, unbonded strain-gage and potentiometer pressure transducers, vibration transducers, accelerometers, galvanometers, and ceramic and precision optical products of the Transducer Div., Consolidated Electrodynamics Corp., a subsidiary of Bell & Howell Co., are described in a new 16-page general catalog, Bulletin 1308.

Address: 360 Siena Madre Villa, Pasadena, Calif.

### Semiconductor Heat Exchangers

Technical Bulletin No. 260 and price list on semiconductor heat exchangers, Series 5000, for medium-pressure forced-air cooling systems using transistors, zener diodes, and rectifiers is available from Wakefield Engrg., Inc., 7 Broadway, Wakefield, Mass.

It contains a complete description of the material, construction, finish, mounting, and ducting and baffling for each of the five Series-5000 models heat sinks. Information is also provided on top covers, hose adapters, and insulating washers.

### Waste-Heat Boilers

A new line of waste-heat boiler is described in Bulletin 1700 just released by the International Boiler Works Co. It contains engineering drawings and specifications on this specialized line of International-LaMont forced recirculation generators designed to make maximum use of waste heat from industrial and process-heat sources.

High-velocity circulation through small-diameter tubes with a patented orificing method assures uniform flow distribution. High heat-absorption rates and output capacities are provided with greatly reduced waste-heat-boiler space requirements.

Requests for the bulletin and inquiries on specific waste-heat applications are invited. Write International Boiler Wks. Co., 111 Oak St., East Stroudsburg. Pa.

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## NEW EQUIPMENT
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### Shock and Vibration Isolators

Bulletin 59.04.10 is a data sheet on Barry Cupmounts Series 4000, shock and vibration isolators for loads up to 900 lb per isolator, available from Barry Controls, Inc., 700 Pleasant St., Watertown 72, Mass. The Cupmounts provide effective protection against high impact shock.

### Molybdenum Products

A nontechnical, descriptive booklet on Climelt molybdenum products has been published by Climax Molybdenum Co., 1270 Sixth Ave., New York 20, N. Y. The 24-page booklet, gives full details on the various sizes, forms, conditions of use, tolerances, weights, and methods of identification of Climelt molybdenum metal and three molybdenum-base alloys.

### Strainers

An 88-page handbook of simplified selection and sizing of industrial and marine strainers has just been published by Tate Engineering, Inc., 516 Eutaw St., Baltimore, Md. The Tate Strainer Guide contains a compilation of reference data for the layout of fluid-flow systems and sizing of strainers, tabulated test results, and valve and pipe-selection information.

### Ball Bearings

Type HDR high-precision radial ball bearings, with load capacities claimed to be 19 per cent to 55 per cent greater than equivalent-size Conrad bearings, are described in Catalog 60, available from Split Ballbearing Div. of MPB, Inc., Lebanon, New Hampshire.

Offered in ABEC-3 and ABEC-5 precision grades, the new bearings made by the company's single-fracture method are available in extremely light, extra light, light, and medium series in metric sizes to 85 mm OD with four ranges of internal clearance.

### Premix Weighing System

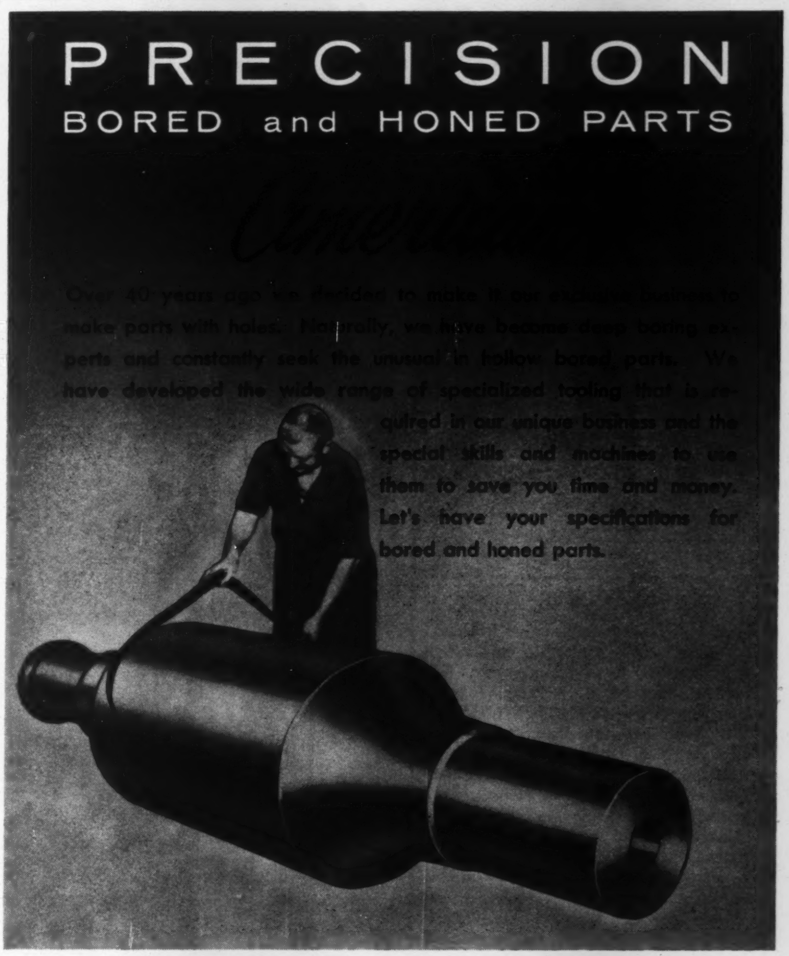
A Select-O-Weigh system for automatic premix blending eliminates human error and provides fast and accurate low-cost proportioning is described in Product Data Sheet No. 5903.

The system is designed by Richardson Scale Co., Clifton, N. J., for punched-card-controlled batch-porportioning operations in which it is necessary to introduce small quantities of special premixed ingredients into the main batch.

### Voltage Regulator

Detailed information on General Electric's new transistorized static voltage regulator which eliminates contacts and moving parts is contained in Bulletin GEA-7068 obtainable from the company at Schenectady 5, N. Y.

The four-page booklet describes how electrical components are card-mounted, placing functional circuits on separate, easily removed cards. To make the regulator more universally applicable, GE engineers have equipped it with set-up features which may be varied.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VISCOSITY OF LUBRICANTS UNDER PRESSURE

This Report reviews twelve experimental investigations made in England, Germany, Japan, Russia, and the United States on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data collected are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent topics such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other sections give the required computation of temperature and pressure coefficients, a bibliography of 189 items, and symbols.

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BUSINESS NOTES
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LATEST CATALOGS

### Solder-Joint Valves

A revised edition of the popular Bronze, Solder Joint Valve circular has recently been published by the Walworth Co., 750 Third Ave., New York 17, N. Y., replacing an earlier one printed in 1957. A No. 2 SJ bronze gate valve, which Walworth recently marketed is included for the first time.

### Belt-Conveyer Idlers

A 48-page engineering and product-information booklet on belt-conveyer idlers has been issued by Hewitt-Robins Inc., Stamford, Conn. Included are details of construction, comparison of 10 competitive designs, selection, procedure and examples, engineering tables, dimensions and specifications. Ask for Bulletin 171.

### Aluminum Coupling

A new type of cast-aluminum coupling, for joining extruded aluminum steam-traced piping, is described in Bulletin PF-1, issued by Alcast Fittings. P. O. Box 151, Claymount, Delaware.

Drawings illustrate three basic types of couplings manufactured. The bulletin also gives prices for the 10 sizes available.

### Variable-Speed Drives

"Type RS P.I.V. Variable-Speed Drives," a six page Folder No. 2874 describes the new Link-Belt Co., Prudential Plaza, Chicago 1, Ill., constant-horsepower variable-speed drives, designed to meet capacity demands up to 50 hp and ratios up to 5.5:1.

The folder describes the new features of a twin-strand single-roll chain that operates between a pair of smooth facing wheels to change the ratio and output-shaft speed as the effective diameter of the wheel faces is altered. In this manner stepless speed adjustments between maximum and minimum settings are achieved.

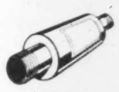
Applications include smooth, precise speed control for heavy machine tools, timing, mixing, synchronizing, conveying and handling systems.

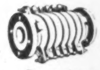
### Pneumatic Instruments

Pneumatic instruments for the process industries are described in a new 12-page Catalog 515, announced by the U. S. Gauge Div., American Machine and Metals, Inc., Sellersville, Pa.

Pressure and temperature pilots and pneumatic transmitters are featured. Pilot specifications are listed and control actions are described. Optional indicating-controller features are covered, including pneumatic set-point, control by-pass, and valve positioner. Pressure and temperature transmitter specifications are also given.

# the only complete line to handle every pipe movement problem!


Flexonics
Expansion Compensators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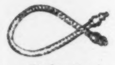
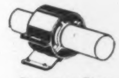
Expansion Joints


Flexonics
Flexible Connectors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Wherever there's pipe movement . . . thermal growth . . . vibration . . . there's a Flexonics product to absorb, guide, or control it.

**Flexonics Corrugated Expansion Joints** are expertly engineered to your needs, hydraulically formed, metallurgically treated by exclusive techniques, for maximum cyclic life. **Flexonics Expansion Compensators** offer the lowest-cost way, inch for inch, to absorb thermal growth in pipes or tubing 3" and smaller. **Flexonics Flexible Connectors** absorb vibration, permit random movement in pipes up to 24". **Flexonics Pipe Alignment Guides** and Roller Pipe Supports provide better guiding than old-fashioned methods, yet they cost less. **Check and mail the coupon today.**

EJMA

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EJ-255

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BUSINESS NOTES
LATEST CATALOGS

### Gears, Differentials, Speed Reducers

Master Catalog F-128 available from Dynamic Gear Co. lists over 50,000 components that are available from stock.

Gears cut to center distance are offered for the first time. By holding this center distance to nominal, a backlash of 0.0002 to 0.0008 intermated eliminates all possibility of binding.

Miniature precision gears, including anti-backlash gears (spring-loaded, solid, and split-hub), spur gears (hub, hubless, and clamp-type), bevel gears (miter and ratio), worms, and mating helical gears are listed. Also included are differentials, speed reducers and gearheads, and transmissions with up to 15 available speeds ranging from 3.3 to 7812 rpm. Standard nominal bore sizes plus bore sizes 2/10's under nominal are also listed. Design kits are available for experimental needs. Write to the company at Dixon Ave., Amityville, N. Y.

### Aircraft Instruments

"Aircraft Instruments" Manual 05-100-B, 48 pages, describes the complete line of aviation instruments and components designed and manufactured by the Weston Instruments Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J.

Specifications, mounting information, and detailed text are provided on installation of ammeters; voltmeters; volt-ammeters; shunts; current transformers; resistance and thermocouple thermometers; resistance bulbs; ILS cross-pointer, trim-tab, frequency, and course indicators; plus luminescent materials for dials and pointers of aircraft instruments.

### Rotoforming

Rotoforming, a new, economical method whereby cold metal is pressure-shaped into desired thicknesses and circular shapes, is fully explained in eight-page Bulletin 500-P4 issued by Commercial Shearing & Stamping Co., Youngstown 1, Ohio.

A description of the machine, various shapes that can be formed, range of possible sizes, types of finishes, and the metals and alloys best suited for rotoforming, are all included. Typical shapes and blanks with 15 representative samples of rotoformed components are illustrated.

### Temperature Controls

Simple and inherently stable temperature-control packages, known as Simplytrols and applicable to a wide variety of industrial processes, are described in a new 12-page Bulletin 108, issued by Assembly Products, Inc., Chesterland, Ohio. Three basic types of thermocouple-actuated controls include a proportioning model that is capable of holding temperature to ± 1 deg F of set point.

### Water and Waste Treatment

Methods and equipment for treating metal-finishing process water and wastes are covered in Technical Reprint T-180, available from Graver Water Conditioning Co., 216 W. 14th St., New York 11, N. Y.

The 12-page article discusses reasons for treatment, how to investigate the problem, modern treatment methods available for hexavalent chromium, cyanides, acids and alkalies, oily wastes, and process water.

Recovery versus disposal are considered as well as instrumentation and the use of Graver's new Hi-Sep Dialysis system for the recovery of valuable products.

### Set-Screw Installation

A capsule review of the relative economics of set-screw installation—by hand, by power tool, and by automatic inserter—is featured in a new four-page Setomatic Bulletin 2302 from Standard Pressed Steel Co., Box 558, Jenkintown, Pa.

The literature covers an improved model of the company's Setomatic automatic set-screw inserter capable of 2500 insertions an hour, that can be used as an attachment to a single machine or as part of a fully automated production line. Because of its exceptional speed, the automatic unit can install set screws for 15¢ per 100, as compared to 51¢ for power tool, and 99¢ for hand-assembly methods, according to the bulletin.

### Electronic Instruments

A new brochure describes the electronic and electromechanical instrument systems available from Liquidometer Corp.

Products and services are described with examples of the indicating and control systems and components the company has supplied for aerospace, marine, and industrial applications.

Typical are electronic fuel-gaging and control systems for jet aircraft, liquid-oxygen gages, position-indicating systems, and a wide range of other precision equipment.

For further information write the company at 41-03 36th St., Long Island City 1, N. Y.

### Pneumatic Conveying

How the largest taconite pelletizing plant on the Mesabi range in Minnesota employs pneumatic conveying to solve handling problems is told in a new bulletin, ER-33-1, offered by Fuller Co., Catasauqua, Pa.

Fine crushed coal and two troublesome additives, bentonite and soda ash, are involved. The enclosed pneumatic system overcame the tendency of the chemicals to become sticky when exposed to humid air. Four separate pneumatic-conveying systems, as well as their components, are controlled by a single huge panel.

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### Super Pressure Tubing

Superpressure tubing capable of carrying internal pressures of 15,000 to 100,000 psi is described in Data Memorandum No. 22 issued by Superior Tube Co., Norristown, Pa. Characteristics, types, and sizes available, and comprehensive statistical tables and pressure formulas are included.

### Magnetic-Particle Clutches

A catalog describing characteristics of a line of 10 different magnetic-particle clutches ranging in capacity from 2.5 oz-in. (0.156 lb-in.) to 1900 lb-in. has been released by Lear, Inc., Box 688, 110 Ionia Ave., N. W., Grand Rapids Mich.

Advantages claimed include high torque-to-inertia ratio; low residual torque; low excitation power for full-output torque; smooth, chatter-free torque transmission; constant performance under environmental extremes; torque independent of speed; torque proportional to excitation and high mechanical-power gain.

### Excavator/Crane

The American Hoist & Derrick Co., 63 So. Robert, St. Paul, Minn., has released a 20-page catalog on the American 200 series crawler excavator crane. Features include the new Positive-Pressure Backhoe, and positive rope crowd shovel attachment. Ask for Catalog No. 720-CG-3.

### Seals

The firm's line of Mechanipak seals is described in Bulletin AD-150 issued by Garlock Inc., of 446 Main St., Palmyra, N. Y.

The bulletin outlines temperature, pressure, shaft-speed, and other critical operating information necessary when selecting or utilizing mechanical-sealing devices. Standard sizes of Mechanipak seals are listed and the construction of various seals and the standard and optional features available are detailed. Examples of typical applications and several engineering specifications forms are included in each bulletin.

### Titanium

"Titanium Facts," includes charts cataloging the various type of titanium and titanium alloys, with their commercial and military code designations, metallurgical properties, and other technical data. Methods of welding titanium by the shielded-arc, spot, seam, and flash methods are also briefly described.

Technical Bulletin No. 100 available from Nooter Corp., 1400 S. Third St., St. Louis 66, Mo.

### Power and Process Piping

Piping systems fabricated and erected by Midwest Piping Co., 1450 S. Second St., St. Louis 4, Mo. for power stations and industrial plants throughout the country are highlighted in a 24-page bulletin, No. 60B.

"Case-history" studies of 17 power plants and 15 industrial plants, with details on each fabrication and erection job are included as well as a section on the complete line of welding fittings and flanges.

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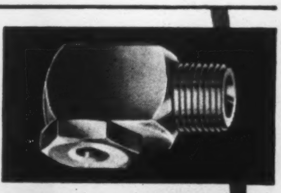
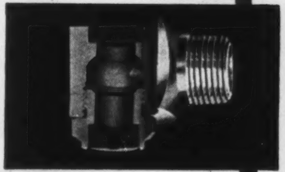
Spray Nozzle



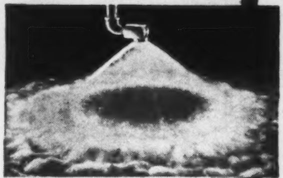
types

choice of over 12,000 basic designs



materials

brass, stainless steel, lead, hard rubber, hardened steel, tungsten carbide and many others.



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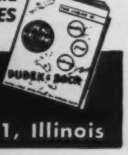

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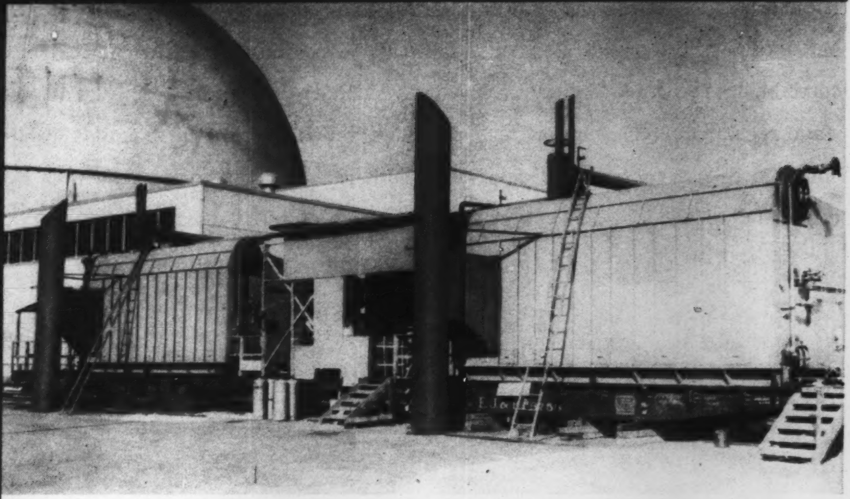

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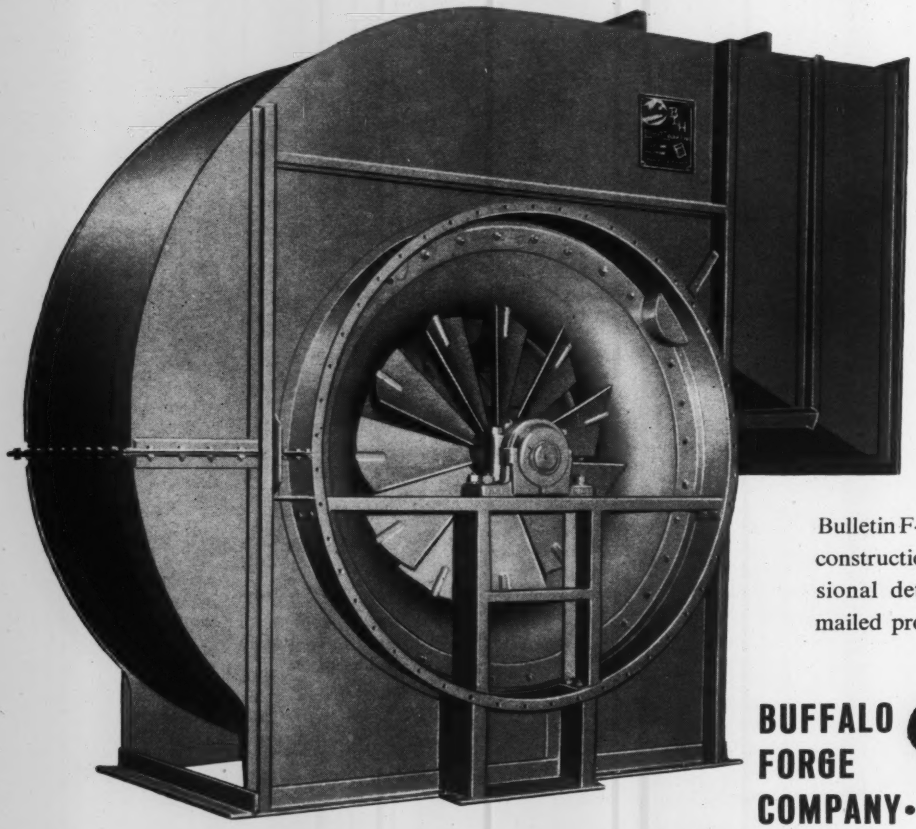

Bulletin F-200 contains performance, construction, capacity and dimensional details. Your copy will be mailed promptly on request.

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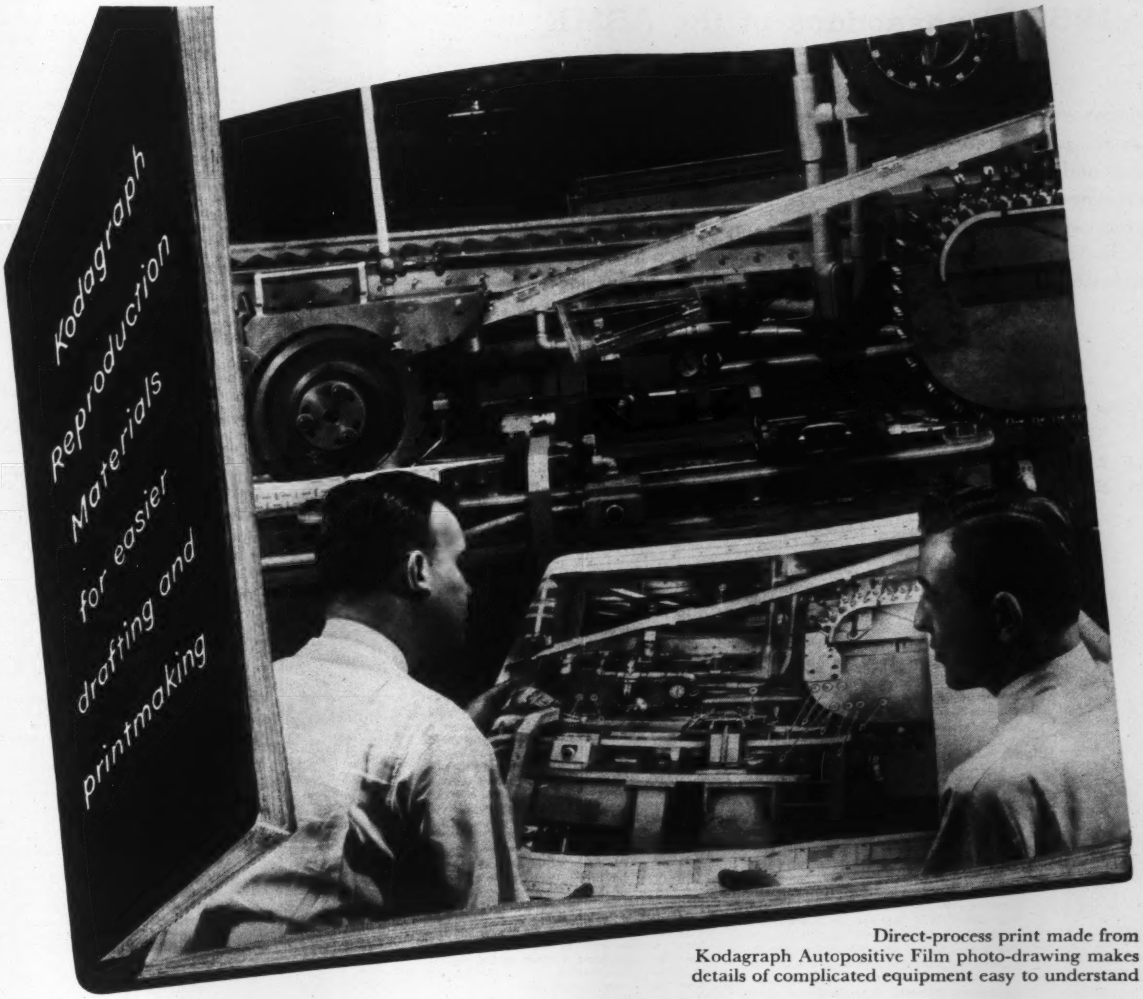

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## 1

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Studies of Air Pollution Control.
Characteristics of Airborne Particles.
Stage Performance and Radial Matching of Axial Compressor Blade Rows.
The Measured and Visualized Behavior of Rotating Stall in an Axial-Flow Compressor and in a Two-Dimensional Cascade.
Availability Balance of Steam Power Plants.
Pulverized-Coal Transport Through Pipes.
Operating Results of an Experimental Supercritical Steam Generator.
Some Notes on the Strength of the Enrico Fermi Reactor Vessel Structure.
Some Thoughts About the Development of Automotive Gas-Turbine Units.
Electrostatic Shaft Voltage on Steam-Turbine Rotors.
The Control System of a 225,000-Kw Double-Automatic Extraction Steam Turbine and Related Reducing Stations
Design of 321-Mw Cross-Compound Steam Turbine—River Rouge Unit No. 3.
Five Years' Experience on the Consolidated Edison System With Protection of Turbine Generators and Boilers by Automatic Tripping.
A Simplified Regenerator Theory.
Development of a Smooth Running, Double-Spool, Gas-Turbine Rotor System.
M-252 Alloy for Heavy-Duty Gas-Turbine Buckets.
The Calibration of Thermocouples by Freezing-Point Baths and Empirical Equations.
Theoretical Stresses Near a Circular Opening in a Flat Plate, Reinforced With a Cylindrical Outlet.
Effect of Steam-Turbine Reheat on Speed-Governor Performance.
Load Capacity Tests on Tapered-Land and Pivoted-Shoe Thrust Bearings for Large Steam-Turbine Application.
Gas Turbine Progress Report Covering: Materials. Turbine Cooling. Fuels. Cycle Components. Compound Piston-and-Turbine Engines. Aviation. Rocket Turbines. Automotive. Railroad. Marine. Industrial and Central Station. Nuclear.
The Aerodynamic Approach to Furnace Design.
Use of Flow Models for Boiler-Furnace Design.
Use of Models for Studying Pulverized-Coal Burner Performance.
Basic Principles of Combustion-Model Research.
A New Performance Criterion for Steam-Turbine Regenerative Cycles.
Power Test Code Thermometer Wells.
Flow-Induced Noise in Heat Exchangers.
The Effect of Fuel Types and Admission Method Upon Combustion Efficiency.
Torsion of a Prismatical Bar Whose Section Is a Crescent.
The Transient Response of Gas-Turbine-Plant Heat Exchangers—Regenerators, Intercoolers, Precoolers, and Ducting.
Stresses in Hollow Cylinders Due to Asymmetrical Heat Generation.
Dynamic Loading of Spur Gear Teeth.
Analytical Design of an Ackermann Steering Linkage.
Structural Error Analysis in Plane Kinematic Synthesis.
The Design of Linkages to Generate Functions of Two Variables.
Helical Springs of Hollow Circular Cross Section.
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Stress and Strain in Spinning Paraboloid Dishes.
Torispherical Shells—A Caution to Designers.
Drilling by Vibration.
Vibrations of Vertical Pressure Vessels.
The Strength of Thick-Walled Cylinders.
Steady-State Creep Analysis of the Weight Loadings of Furnace Tubes on Multiple Supports.
How to Replace Gears by Mechanisms (Linkages).
The Effect of a Lead Additive on the Machinability of Alloy Steels.
Controlled Contact Cutting Tools.
A Study of the Effects of Tool Flank Wear on Tool Chip Interface Temperature.
Synthesis of Path-Generating Mechanisms by Means of a Programmed Digital Computer.
Synthesis of the Four-Bar Linkage to Match Prescribed Velocity Ratios.
High-Range Plasticity of Metals Beyond Normal Work-Hardening.
Self-Excited Vibrations in Metal Cutting.
Factors Influencing the Performance of Grinding Wheels.
Vibrations of Flexible Precision Grinding Spindles.
The Effect of Process Variables on Extrusion Pressures of Lead.
Approximate Solutions to a Problem of Press Forging.
Theory and Experiment of Press Forging Axisymmetric Parts of Aluminum and Lead.
A Three-Dimensional, Tool-Life Equation—Machining Economics.
Observations on the Shearing Process in Metal Cutting and on the Angle Relationships in Metal Cutting.
Dynamic Problems Associated With Satellite Orbit Control.
Study of Machinability of Metals.
Four-Bar Linkages—Approximate Synthesis.
A Theory for the Effect of Mean Stress on Fatigue of Metals Under Combined Torsion and Axial Load or Bending.
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Power Heat Balance Considerations in Design and Operation of Industrial Plants.
Influence of Hot and Cold Storage-Loads on the Refrigerated-Space Temperature of a Cooling Complex.
Development and Uses of a New Line of Vibratory Feeders and Unit Vibrators.
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## 2

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Prediction of Choking Flow in Centrifugal Impellers.
Concerning Subharmonic Oscillations Which May Exist in Nonlinear Systems Having Odd Restoring Forces.
An Analytic Frequency-Response Solution for a Higher Order Servomechanism With a Nonlinear Control Element.
Antifriction Instrument-Bearing Torque Testing and the Resistance to Motion of Such Bearings.
Analysis and Characteristics of the Three-Lobe Bearing.
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Axial, Relative Motion of a Circular Step Bearing.
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Friction Factors for Turbulent Flow in Curved Pipes.
Characteristics of a Self-Lubricated Stepped Thrust Pad of Infinite Width With Compressible Lubricant.
Direct Measurement of Net Positive Suction Head.
Transitional Phenomena in Ultrasonic Shock Waves Emitted by Cavitation on Hydrofoils.
Cavitation and NPSH Requirements of Various Liquids.
The Unsteady Wake Interaction in Turbomachinery and Its Effect on Cavitation.
Thermal-Stress Ratchet Mechanism in Pressure Vessels.
Refractory Metal Facings for Protection of Metal Surfaces Subjected to Repeated High-Temperature Pulses.
The Failure of Structural Metals Subjected to Strain-Cycling Conditions.
Evaluation of Material Wear and Self-Welding in Sodium-Cooled Reactor Systems.
Irradiation of Haynes-25 and Inconel-X Compression Springs in High-Temperature High-Pressure Water.
Energy Losses of Balls Rolling on Plates.
On the Effect of Lubricant Inertia in the Theory of Hydrodynamic Lubrication.
Surface Finish and Clearance Effects on Journal-Bearing Load Capacity and Friction.
Statistical Optimization of Regulators Employing a Binary Error Criterion.
An Introduction to the Time-Modulated Acceleration Switching Electrohydraulic Servomechanism.
Static and Dynamic Control Characteristics of Flapper-Nozzle Valves.
Some Measurements of Boundary-Layer Growth in a Two-Dimensional Diffuser.
The Skewed Boundary Layer.
On the Nature of Stall.
Optimum Design of Straight-Walled Diffusers.
Labyrinth-Seal Leakage Analysis.
Centrifugal Manometer.
The Aerodynamic Design of Two-Dimensional Turbine Cascades for Incompressible Flow With a High-Speed Computer.
An Analysis of Axial Compressor Cascade Aerodynamics, Parts I and II.
Loss and Stall Analysis of Compressor Cascades.
Stall Prediction in Gas-Turbine Engines.
A Survey of Stall Propagation—Experiment and Theory.
Modulation Phenomena in Stall Propagation.
Studies of Jet Compression—I, Apparatus and Methods. Results With Air at Room Temperature.
Applications of Computer and Model Studies to Problems Involving Hydraulic Transients.
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Experience in the Use of the Gibson Method of Water Measurement for Efficiency Tests of Hydraulic Turbines.
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Symposium on Welded Spiral Cases From the Manufacturer's Viewpoint.
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Reversible Pump-Turbines for Sir Adam Beck-Niagara Pumping-Generator Station.
Some Hydraulic Features of Puntledge Generating Plant.
Application of Boundary-Layer Theory in Turbomachinery.
Radial Equilibrium in Supersonic Compressors.
Résumé of the Supersonic-Compressor Research at NACA Lewis Laboratory.
Application and Analysis of a Computer Control System.
The Response of Pneumatic Transmission Lines to Step Inputs.

Regulators, Lubrication, and Metals Engineering Divisions, and the Research Committee on the Effect of Temperature on the Properties of Metals.

A General Approach to the Practical Solution of Creep Problems.
Multiaxial Creep Studies on Inconel at 1500 F.
Creep-Rupture Strength of Austenitic Cr-Ni-Mo Steels in Sheet and Bar Form.
Correlation of High Temperature Creep and Rupture Data.
Comparison of Parameter Methods for Extrapolating High-Temperature Data.
Tests on Deflection of Flat Oval Bourdon Tubes.
Bending and Stretching of Corrugated Diaphragms.
Electromagnetic Flowmeter Primary Elements.
The Distribution of Contact Pressures in the Rolling of Metals.
The Effects of Friction in the Rolling of Metals.

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Wave Theory of Heat Transfer in Film Boiling.
A Boundary-Layer Treatment of Laminar-Film Condensation.
Transient Response of Heated Air in an Enclosure With Heat Losses.
Natural-Convection Heat Transfer in Liquids Confined by Two Horizontal Plates and Heated From Below.
Transient Heat Transfer for Laminar Forced Convection in the Thermal Entrance Region of Flat Ducts.
Generalized Correlation of Boiling Heat Transfer.
Heat Transfer to a Boiling Liquid—Mechanism and Correlations.
Transient Heat Conduction in Elliptical Plates and Cylinders.
Calculation of Transients in a Cross-Flow Heat Exchanger.
Free Convection, Forced Convection, and Acoustic Vibrations in a Constant Temperature Vertical Tube.
Summary—Selected References on Gas Turbines, Regenerative Cycles, Rotary Regenerators, and Associated Heat-Exchange and Pressure-Drop Information.
Investigation of Heat Transfer, Flow, and Heat Exchangers as Related to Turbine Cooling.
Progress and Development of Gas-Turbine Regenerators.
Heat Transfer and Friction for Fluids Flowing Over Surfaces at High Temperatures and High Velocities.
A New Technique for Measuring the Spectral Emissivity of Solids at High Temperatures.
Heat and Mass Transfer From a Rotating Disk.
Numerical and Machine Solutions of Transient Heat-Conduction Problems Involving Melting or Freezing, Part I.
A Theory of Rotating Condensation.
Laminar Heat Transfer in Rectangular Channels.
Heat Transfer to Water in Thin Rectangular Channels.
Combined Geometric and Network Analog Computer for Transient Heat Flow.
Heat Transfer From an Annular Fin of Constant Thickness.
A Variational Method for Fully Developed Laminar Heat Transfer in Ducts.
The Effect of Surface Roughness on the Convection Heat-Transfer Coefficient for Fully Developed Turbulent Flow in Ducts With Uniform Heat Flux.
Heat Transfer Between Concentric Rotating Cylinders.
Full-Scale Human-Body-Model Thermal Exchange Compared With Equational Condensation of Human Calorimetric Data.
The Emissivity and Absorptivity of Parachute Fabrics.
An Experimental and Analytical Study of Vortex-Flow Temperature Separation by Superposition of Spiral and Axial Flows—Parts 1 and 2,
Analysis of the Aerodynamic Heating for a Re-Entrant Space Vehicle.
A Photographic Study of Boiling in the Absence of Gravity.
Some Radiator Design Criteria for Space Vehicles.
Optimization of a Conventional-Fuel-Fired Thermoelectric Generator.
Dynamic Response of Heat Exchangers Having Internal Heat Sources—Part III.
Heating and Cooling Air and Carbon Dioxide in the Thermal Entrance Region of a Circular Duct With Large Gas to Wall Temperature Differences.
Turbulent Fow in a Circular Tube With Arbitrary Inernal Heat Sources and Wall Heat Transfer.
Laminar Condensation Heat Transfer on a Horizontal Cylinder.
The Use of Thin Films for Increasing Evaporation and Condensation Rates in Process Equipment.
Some General Considerations of the Heating of Satellites.
The Penetration of Planetary Atmospheres.
Thermodynamic Properties of Helium at Low Temperatures and High Pressures.
Radiation Fin Efficiency for One-Dimensional Heat Flow in a Circular Fin.
Heat Transfer From a Rotating Disk to Fluids of Any Prandtl Number.
An Approximate Treatment of Unsteady Heat Conduction in Semi-Infinite Solids With Variable.
Thermal Properties.

## 3

Section 3—APPLIED MECHANICS. Presentation and publication of the fundamental analytical and experimental studies in this section were sponsored by the Applied Mechanics Division.

Experimental Surface-Wave Method for Recording Force-Time Curves.
Forced Torsional Vibration of Systems With Distributed Mass and Damping.
Frequencies of a Flexible Circular Plate and Light Elastic Half-Space.
Analytical Design of Disk Cams by Independent Position Equations.
Stress Distribution and Plastic Deformation in Rotating Cylinders.
Transient and Residual Stresses in Heat-Treated Cylinders.
The Nonlinear Bending of Thin Rods.
Stresses and Deflections in Circular Plate Loaded Over a Segment.
Transverse Flexure of a Thin Plate Containing Two Circular Holes.
Limit Analysis of Symmetrically Loaded Thin Shells of Revolution.
On Influence Coefficients and Nonlinearity for Thin Shells of Revolution.
A Theorem of Maximum Strain Energy.
Plastic Stress-Strain Relationships—Effect of Loading Path and History.
A Stress-Strain Relation for Hexagonal Close-Packed Array of Spheres.
A Mathematical Model of the Stress-Strain Diagram and Hysteresis Loop.
A Definition of Stable Inelastic Material.
Retarded Flow of Bingham Materials.
An Experiment on Compressible-Flow Perturbations.
Transient Film Condensation.
Effect of Turbulence on Slider-Bearing Lubrication.
Theory of Flight of the Sounding Rocket.
On Supersonic Wind Tunnels With Low Free-Stream Disturbances.
Velocity and Temperature Fluctuation Measurements in a Turbulent Boundary Layer.
Density Variation Effects in Stepped-Thrust Bearings.
Response of a Nonlinear String to Random Loading.
Response to Van Der Pol's Oscillator to Random Excitation.
A Perturbation Solution of the Equations of Motion of a Gyroscope
Vibration of Beam-Mass Systems With Time-Dependent Boundary Conditions.
Dynamic Loading Tests of an Aircraft-Type Beam.
Viscous Damping in Flexural Vibrations of Bars.
Natural Modes and Their Stabilty in Two-Degree-of-Freedom Systems.
On Finite Bending of Pressurized Tubes.
Instability and Folding Deformation of a Viscoelastic Medium in Compression.
Stress Distribution in Semi-Infinite Strip Subjected to Concentrated Load.
Postbuckling Behavior of Rectangular Plates With Small Initial Curvature.
New Theory of Elastic Sandwich Plates—One-Dimensional Case.
On Invariant Perforation in an Infinite Strip.
Thermal Stresses in Moderately Thick Elastic Plates.
Analysis of Plane Stress in Polar Co-ordinates.
The Stress Function of a Radial Strain.
Determination of Safe Loads of Beams Subjected to Twisting and Bending Moments.
Effect of a Nonisothermal Free Stream on Boundary-Layer Heat Transfer.
Visual Studies of the Wall Layers in the Turbulent Boundary Layer.
Unsteady Laminar Boundary Layers Over an Arbitrary Cylinder.
On Journal Bearings of Finite Length With Variable Viscosity.
Analysis of Complex Kinematic Chains With Influence Coefficients.
A Theory of Oil Whip.
On Critical Speeds of a Shaft Supported by a Ball Bearing.
Root-Locus Analysis of Structural Coupling in Control Systems.
Normal Vibrations of Uniform Plate Carrying Any Number of Finite Masses.
Transients in Simple Undamped Oscillators Under Inertial Disturbances.
On Laterally Loaded Semicircular Plate With Clamped Edges.
Direct Determination of Stresses in Plane Elasticity Problems.
Stresses in a Stretched Slab Having a Spherical Cavity.
Influence Coefficients for Edge-Loaded Short, Thin, Conical Frustrums.
Upper and Lower Bounds for Special Eigenvalues.
Analysis of a Compression Test of a Model of a Granular Medium.
A Reassessment of Deformation Theories of Plasticity.
Collapse Loads of Rings and Flanges Under Uniform Twisting Moment.
Creep of Thick-Walled Tubes Under Internal Pressure.
Strain-Hardening Solutions to Plate Problems.
Determination of Creep Deflection of a Rivet in Double Shear.
Boundary-Layer Solution for a Flow in a Diverging Passage Having a Swirl Component
Slow Rotatory Motion of a Circular Disk About One of Its Diameters in a Viscous Fluid.
Thermal Stresses Owing to a Hot Spot in a Rectangular Strip.
Impact and Moving Loads on a Slightly Curved Elastic Half Space.
Stability of Forced Oscillations With Nonlinear Second-Order Terms.
On Inertia Effects in a Transient Thermoelastic Problem.
Coupled Torsional and Longitudinal Vibrations of a Thin Bar.
Production of Rotation in a Confined Liquid Through Translational Motion of the Boundaries.
Nonlinear Creep Deformations of Columns of Rectangular Cross Section.
Forced Vibrations of a Circular Plate.
On the Propagation of Shock Waves in a Nonhomogeneous Elastic Medium.
The Frequency of Flexural Vibration of Rectangular Orthotropic Plates With Clamped or Supported Edges.
Axially Symmetric Extensional Vibrations of a Circular Disk With a Concentric Hole.
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Stresses in an Ellipsoidal Rotor in a Centrifugal Force Field.
Carrying Capacity of Elastic-Plastic Shells With Various End Conditions.
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### DESIGN DATA AND METHODS

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The Frequency of Vibration of Rectangular Isotropic Plates.
Factors of Stress Concentration Due to Elliptical Fillets.

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Buoyancy Effects in Forced-Convention Flow. Thermally Induced Twists in Thin Plates. Deflections and Vibrations of Clamped Sectorial Plates. Thermal Distributions Without Thermal Stresses. Thin-Walled Cylinders Under Torsion and Pressure. Transient Heat Transfer for Flow in Ducts. Upper and Lower Bounds for Stiffness of Plates. Cross-Section Distortion and the Timoshenko Beam Equation. Analysis of Paraboloidal Shells. Natural Frequencies of Two Nonlinear Systems. Response of a Slab to Impact. Thermal Stresses in Long Cylindrical Shells. Dynamic Characteristics of Undamped Vibration Systems. Large Deflections of a Clamped Elliptical Plate. Thermal Stresses at Spherical Cavities. Deflection of a Thick Ring in Diametral Compression. The Biot-Willis Coefficients for a Sandstone. Circular Plates on Elastic Foundation. Frequencies of Vibration of Stiffened Plates. Design of a $\pi$ Network for Heat-Flow Analog. Stress Distribution in a Square Tube. Creep of Elastic Belt on a Pulley. Modification of Rayleigh's Principle for Calculating Beam Frequencies. Yield Point Load of an Annular Plate. Analysis of Indeterminate Structures by Displacement Method. Internal Damping of Thermal Origin in Thin Wires. Lateral Buckling of Tapered Narrow Beam. Stresses in Infinite Wedges Tapered in Width and Thickness. Minimization of Spring Torque. Steady-State Response of Linear Vibration Systems. Further Understanding of Shakedown Theorems. Series Solution for Ellipsoidal Shells.

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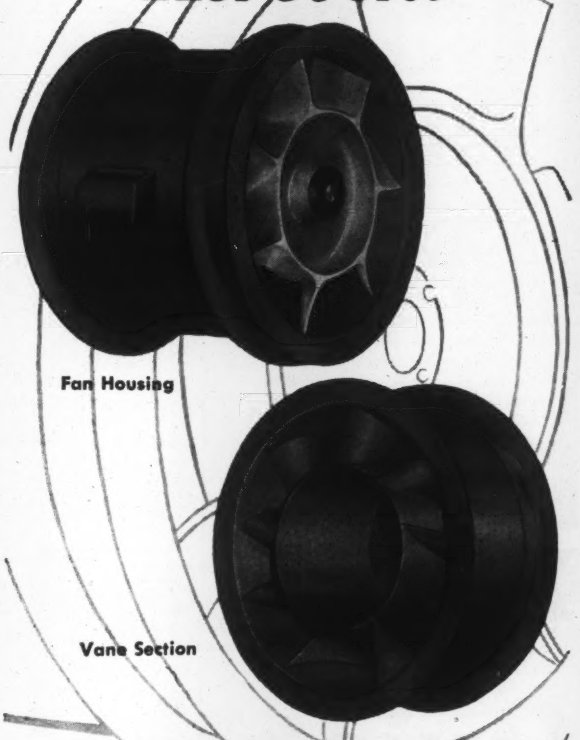

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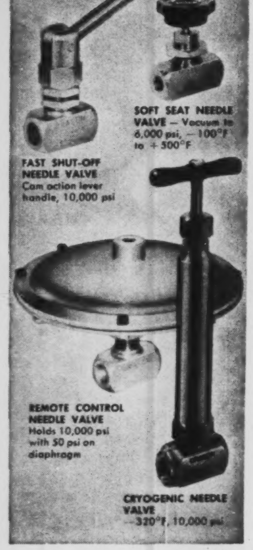
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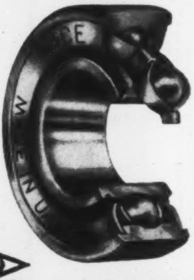

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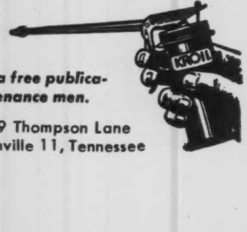

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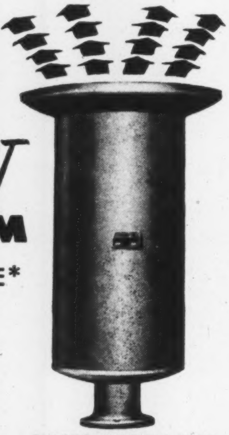

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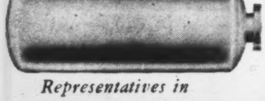

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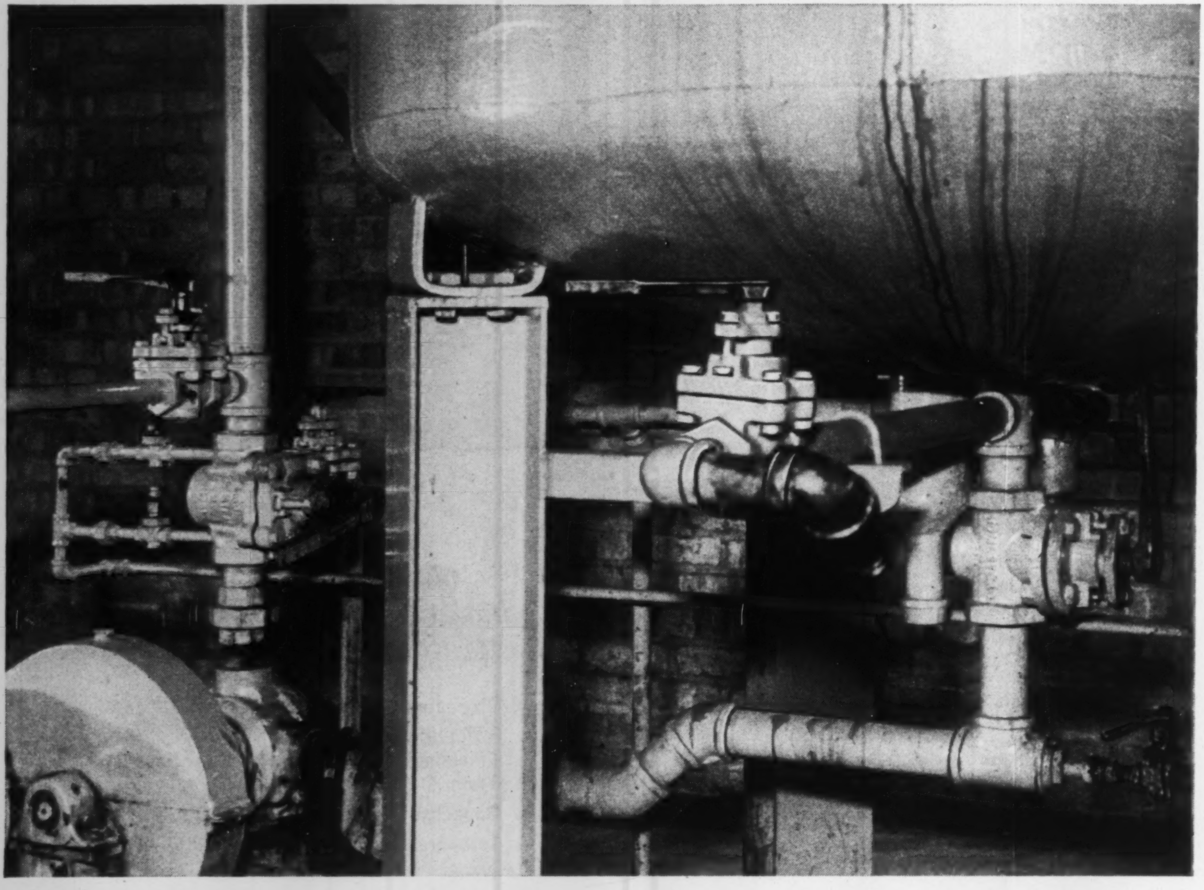

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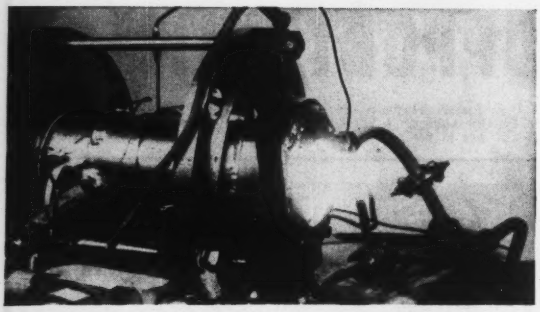

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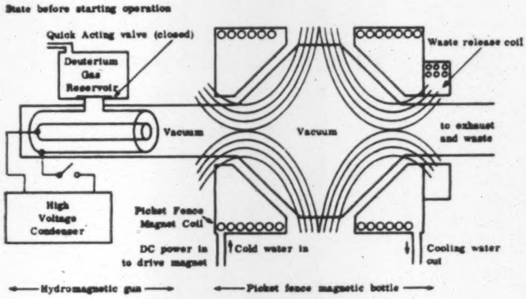
*Is this the shape of things to come in Sherwood?*



The cusped geometry or picket fence was proposed back in 1954 independently by Grad at N.Y.U. and Tuck at Los Alamos, to get around hydromagnetic instability of plasma-magnetic field interfaces. Nobody did much about it at the time. The pinch effect seemed to hold more promise, so why bother about a leaky picket fence? A large magnet to produce a DC picket fence geometry was built but laid aside. For several years the stabilized toroidal pinch (called Perhapsatron at Los Alamos) held the stage. But as our measuring techniques got better, the pinches began to show a most sinister behavior. An apparently stabilized pinch which should have been radiating energy at the rate of several kilowatts, turned out to be losing it at a rate of hundreds of megawatts. As we got the impurities out of the system, the losses seemed to go down. One pinch (Perhapsatron S-5) has seemed so clean we are trying to raise its temperature to thermonuclear levels by pouring in more power.

Then there appeared the spectre of plasma oscillations and their evil effects on magnetic confinement. In principle, plasma oscillations can thrive on the interaction of a fast wind of plasma electrons moving through a slower cloud of plasma ions. This makes things look bad for the pinch effect, because the plasma has to have a large electric current in it, and therefore an electron wind.

The Russians delivered the next blow. Trubnikov and Kondryatsev predicted an enormous cyclotron radiation flux from a plasma containing a magnetic field. This would ruin the chances for DD reactors, and make things tough even for DT reactors. Among other complications, a nearly perfect mirror would have to be placed around the inner wall of the plasma container to reflect the radiation back.

Then Rosenbluth and Drummond argued that when the angular distribution is considered, the radiation isn't really so bad—say 1/50th of what T and K say. Now Trubnikov has come right back with another paper that says it is five times worse than R and D said it was. The above theories are pretty simple—the real problem is exceedingly difficult theoretically. It may be quite a while before there is anything new in this direction.

Anyhow, the point is that DD reactors with magnetized plasmas now seem to be out. But some people, like Tuck, claim that DD reactors are the only ones that make sense, since a DT reactor which must carry on its back a monstrosity of a tritium recovery plant could never compete with fission power anyhow.

This brings us to the point that if we want to have a DD reactor, it has to have no magnetic field in its plasma. So all right, don't put a magnetic field in the plasma. Unfortunately, there aren't any magnetic confinement systems stable enough to hold a pure plasma, except one. You've guessed it—it's the picket fence.

So we went back to the warehouse and dusted off the magnet we built long ago. Already it is going full blast, a second one has been built and a third one is on its way. Of course, we aren't alone any more in this field. Small cusped geometries are being studied at General Atomic, Livermore, Stevens, Harwell, Utrecht and Kharkov. Pretty soon we will have only picket fences and plasma guns at Los Alamos, aside from a few Scyllas to study plasma at thermonuclear temperatures, unless old Perhapsatron S-5 does something pretty spectacular.

The diagram of Picket Fence I (above), run by D. Hagerman and J. Osher, shows how plasma is injected as a slug, strong enough to push through the magnetic field and spread out inside. (This is called entropy trapping, but that's another story). Does it work? Well, that depends. It's a lot more complicated than we thought. At first, we nearly died of joy when the plasma was shot in and seemed to stay around for ages in our time scale (1000 microseconds), emitting light in the process. But when a magnetic probe was inserted, the harsh truth was revealed—the containment lasted only a few microseconds. In other words, the long time period we thought we had observed was merely cold plasma emitting light by recombination.

Just lately, however, Messrs. Hagerman and Osher have cleaned things up to the point that hot plasmas are pushing the field aside strongly and are keeping the inside field pushed aside for very satisfying periods, like 50 microseconds. Also, if we keep the magnetic probe out of the way of the plasma, it stays around longer, which is what it should do. This particular picket fence is a horror to keep a vacuum in, as it is completely overrun with O rings. The next one will be baked. Fun, eh?

What about the leaks in the fence? It is pretty leaky, but we think we have an answer to that too, so watch for the story on the TLC picket fence one of these days.

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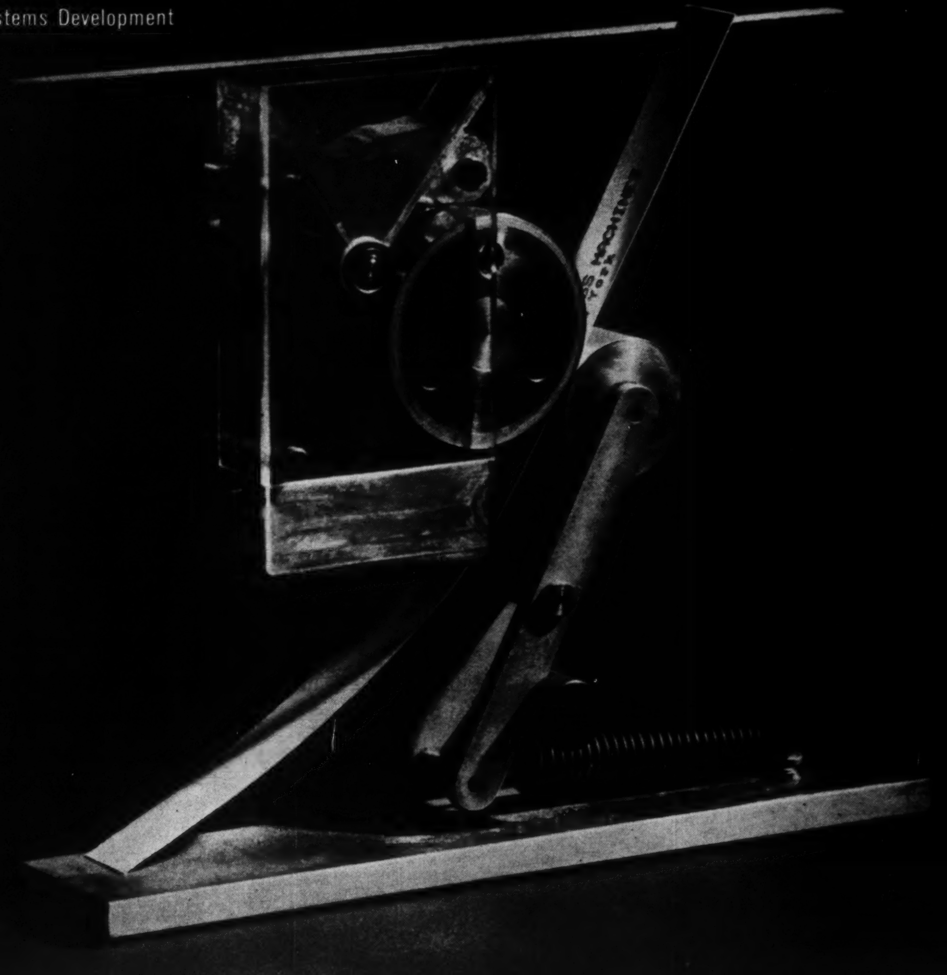
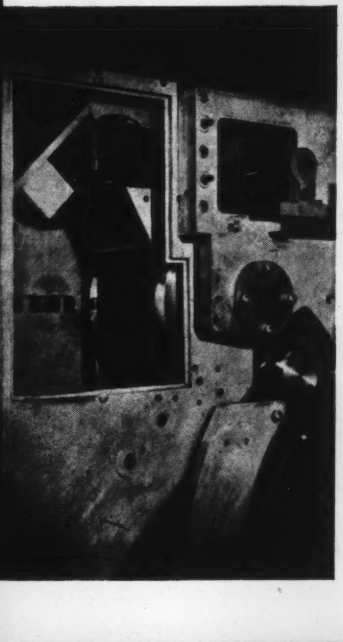


## Bringing to life the principles of magnetic printing



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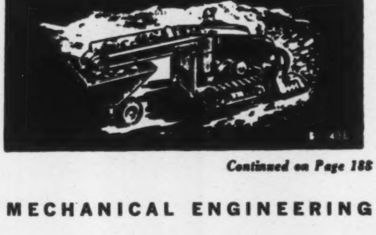

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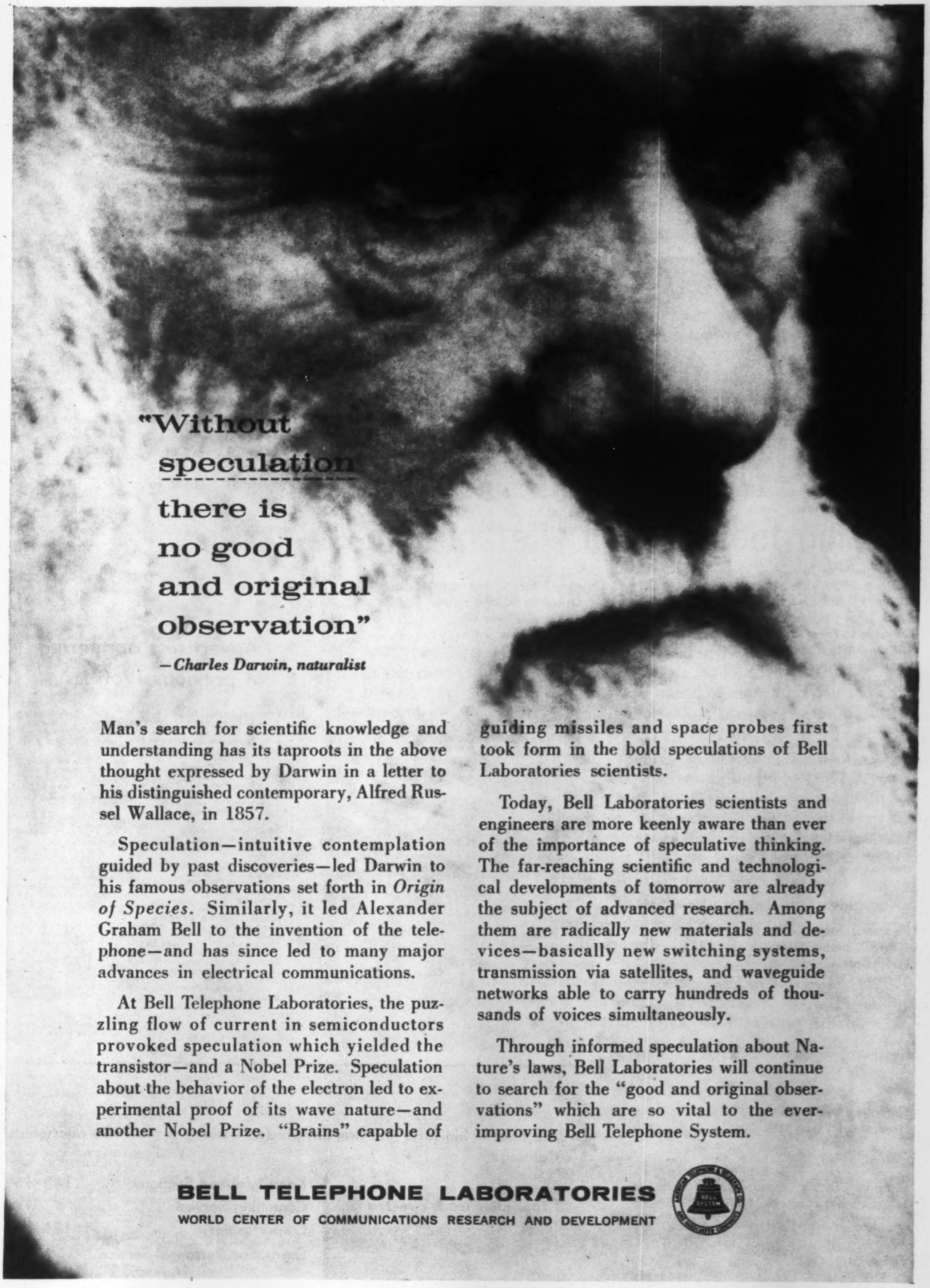

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- Demag
- *Detroit Stoker Co.
  - Div. United Industrial Corp.
- DeZurik Corp.
- *Diamond Power Specialty Corp.
- Dresser Industries, Inc
  - Pacific Pumps, Inc.
- Roots-Connersville Blower Div.
- du Pont, E. I., de Nemours & Co.

- Eagle Pencil Co.
- Ellison Draft Gage Co.
- *Erie City Iron Works

- *Fairbanks, Morse & Co.
- *Falk Corp.
- Fiske Bros. Refining Co.
  - Lubriplate Div.
- *Fly Ash Arrestor Co.
- *Foster Wheeler Corp.
- Fulton-Sylphon Div.
  - Robertshaw-Fulton Controls Co.

- *Gear Specialties, Inc.
- General Atomic
  - Div. General Dynamics
- General Motors Research Labs.
- General Radio Co.
- German American Chamber of Commerce
- *Golden-Anderson Valve Specialty Co.
- Gray Tool Co.
- Green Fuel Economizer Co.
- *Grinnell Co.

- Helitork
  - Div. of Earle Gear & Machine Co.

- *Illinois Gear & Machine Co.
- *Ingersoll-Rand Co.

- *James, D. O., Gear Mfg. Co.
- Johnson, Carlyle, Machine Co.

- Kellogg, M. W., Co.
- Kennedy Valve Mfg. Co.

- Lefax Publishers
- Lenape Hydraulic Pressing & Forging Co.
- Lovejoy Flexible Coupling Co.
- Lubriplate Div.
  - Fiske Bros. Refining Co.
- Lukens Steel Co.
- Lunkenheimer Co.

- McDonnell & Miller, Inc.
- McGraw-Hill Book Co.

- Mercury Clutch Div.
  - Automatic Steel Products, Inc.
- Merriman Bros.
  - Lubrite Div.
- *Midwest Piping Co.

- Nagle Pumps, Inc.
- National Coal Association
- Niagara Blower Co.
- Nordberg Mfg. Co.

- Ohio Gear Co.
- Ohio Injector Co.
- Oldsmobile Div. General Motors Corp.
- Ozalid Div.
  - General Aniline & Film Corp.

- PIC Design Corp.
  - Sub. Benrus Watch Co.
- Pacific Pumps, Inc.
  - Div. of Dresser Industries, Inc.
- *Pangborn Corp.
- Perfection Gear Co.
  - American Stock Gear Div.
- Philadelphia Gear Corp.
- *Posey Iron Works
- Precision Products Dept.
  - Nortronics Div., Northrop Corp.

- Raybestos-Manhattan, Inc.
  - Manhattan Rubber Div.
  - Packing Div.
- Robertshaw-Fulton Controls Co.
  - Bridgeport Thermostat Div.
  - Fulton-Sylphon Div.
- Roots-Connersville Blower Div.
  - Dresser Industries, Inc.
- Rust-Oleum Corp.

- Sly, W. W., Mfg. Co.
- Stephens-Adamson Mfg. Co.
- Stock Equipment Co.
- *Struthers Wells Corp.
  - Titusville Iron Works Div.
- *Syntron Co.

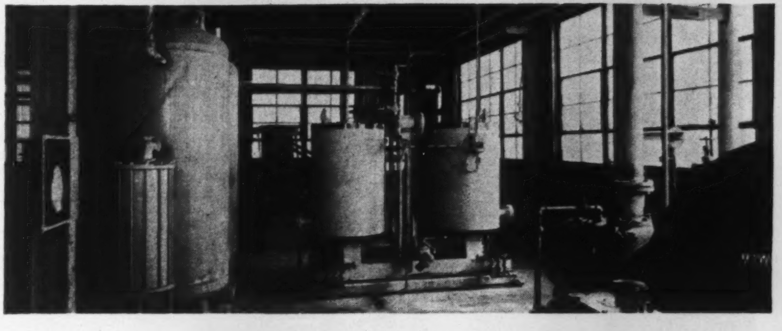
- *Terry Steam Turbine Co.
- *Titusville Iron Works Co.
  - Div. Struthers Wells Corp.

- Uni-Flex Mfg. & Engrg., Inc.
- United States Graphite Co.
  - Div. Wickes Corp.

- W-K-M Div. of ACF Industries, Inc.
- Wabash Metal Products Co.
- Waldes Kohinoor, Inc.
- *Wheeler, C. H., Mfg. Co.
- Whiton Machine Co.
- Williams Gauge Co.
- Wollensak Optical Co.

- York Corp.
  - Sub. Borg-Warner Corp.
- *Yuba Consolidated Industries, Inc.

- *Zallea Bros.
- Zonolite Co.



# Sohio installs central Lectrodryer for plant's instrument air

The BWC-750 Lectrodryer shown above is serving the fluid catalytic cracking unit at Standard Oil Company (Ohio) in Lima. Replacing two smaller units, it delivers air at -100°F in a volume well ahead of maximum demand. Now there's no chance of instrument failure because of air-line freezeups, no rust or mud to clog instrument ports.

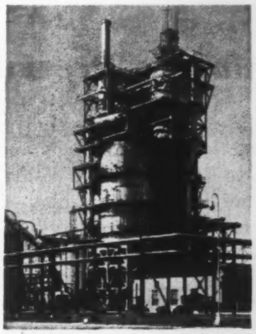
In refineries and other processing plants, small dryers have often been placed at outlying locations, near the operations they serve. This meant many dryers to service and the possibility of freezeups between the air compressor and dryers. Many of these smaller dryers are being replaced with single, large Lectrodryers, able to dry all the air a plant uses.

*Case history sheets* describing drying operations involving a few cubic feet of air per hour or thousands—drying other gases or organic liquids—will be sent at your request. Tell us your drying problem and we'll recommend drying methods and equipment. Write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pa.

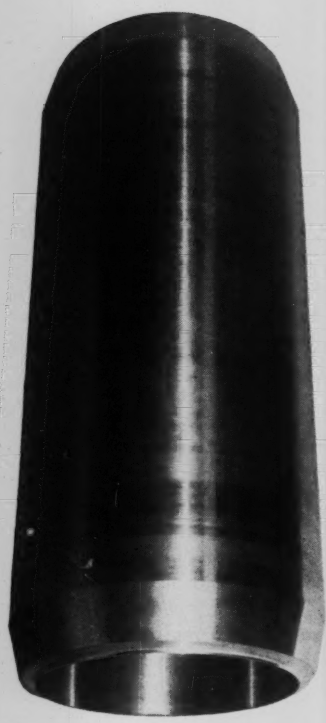
KEEP IT DESERT-DRY WITH...

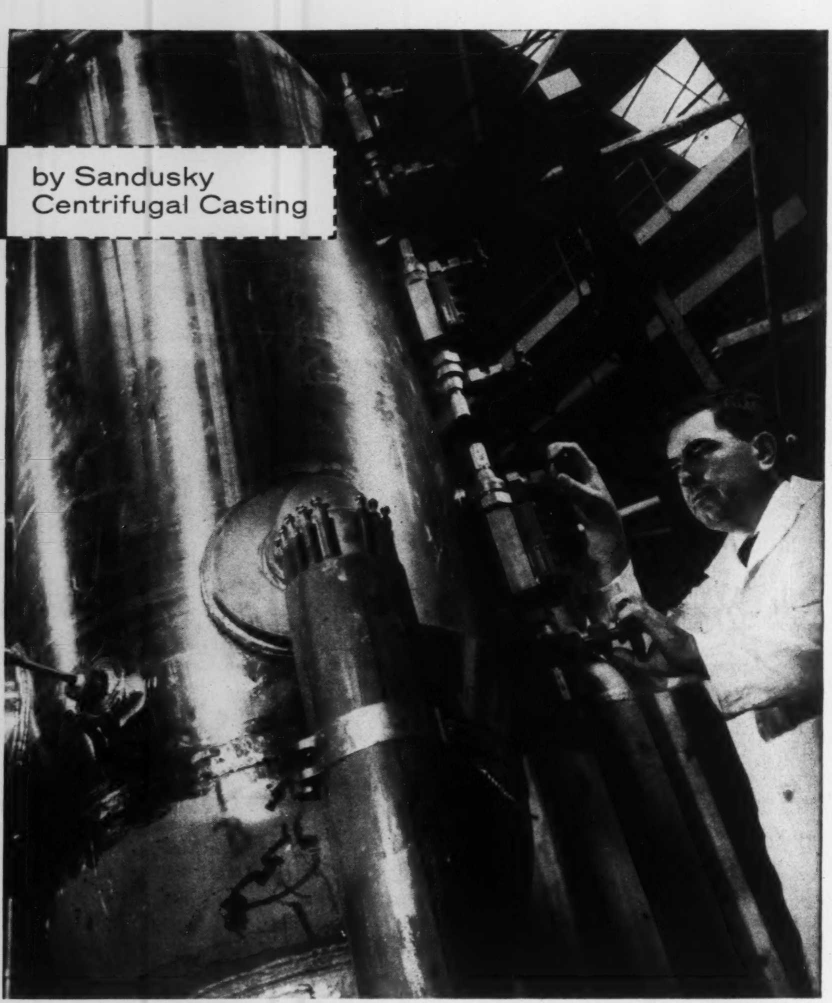
Lectrodryer®

McGRAW EDISON



**SOLVED:** by Sandusky Centrifugal Casting





This photo, showing the Sandusky cylinder welded into position, courtesy of the Lummus Company, New York. New York who fabricated, assembled and tested the completed loop before shipping it to the ETR site in Idaho.

## Nuclear Test Loop Uses Sandusky Centrifugal Casting as Pressurizer Cylinder

A Sandusky Centrifugal Casting is the main cylindrical component of an electrically heated pressurizer, designed by Knolls Atomic Power Laboratory to Section VIII, of the ASME Code (Unfired Pressure Vessels) for use in the new Engineering Test Reactor facilities at Idaho Falls, Idaho.

This 66¼″ long cylinder, 27″ O.D. with walls 2½″ thick, was centrifugally cast of an 18-8 stainless steel (SA-351, Grade CF-8) for the extra corrosion resistance required under nuclear loop service conditions: demineralized water at temperatures to 650°F and pressures to 2500 PSI.

O. G. Kelley Co., Boston, to whom we delivered this 2-ton, fully machined cylinder, welded on the forged heads and nozzles, radiographed the welds, and hydro tested the completed vessel to 4300 PSI.

This is another example of the adaptability of Sandusky Centrifugal Castings to applications demanding the highest order of quality. They may well offer you a practical and economical answer to your cylindrical needs, also.

We are producing cylinders and piping in diameters from 7″ to 54″—in lengths to 33 ft.—in a wide range of ferrous and non-ferrous alloys. Write for Bulletin 300, for more complete technical information on the Sandusky process and product application data.

**SANDUSKY** CENTRIFUGAL CASTINGS
**FOUNDRY & MACHINE CO.**

SANDUSKY, OHIO—Stainless, Carbon, Low-Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys

5903

**CARBORUNDUM'S**

TECHNICAL
INFORMATION ON
UNUSUAL REFRACTORIES

**Data sheet**

*Choosing materials for*

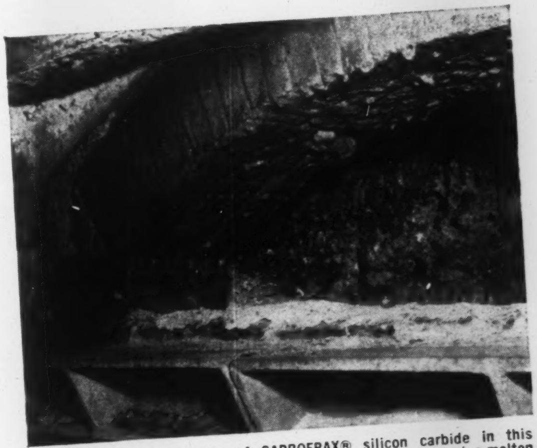
# CORROSION RESISTANCE

Though seldom associated with resistance to corrosion, certain refractories made by Carborundum outlast and outperform other materials of construction—as the table below indicates.

These special refractories withstand many gases, acids, salts and molten metals. They can be used as small, specialized parts or as complete hearths, walls, and roofs of large furnaces and other processing equipment, (see pictures at right).

In addition to essential corrosion resistance, these unique refractories withstand temperatures of from 2800°F to over 3000°F, carry heavy imposed loads, and are virtually unaffected by abrasion.

The tables below offer a very rough guide to properties and applications. Feel free to call on Carborundum for more comprehensive data that can be used in solving your particular problem.



Arch, jambs and sidewalls of CARBOFRAX® silicon carbide in this aluminum reverberatory furnace have resisted attack by corrosive molten aluminum for more than two years.

These parts of REFRAX® nitride-bonded silicon carbide, a Carborundum refractory, have exceptional resistance to corrosion. They are made in complex and accurately dimensioned shapes. Adapted to many installations, REFRAX shapes frequently outlast expensive alloys.

## TYPICAL APPLICATIONS INVOLVING SEVERE CORROSION

- Generators handling superheated steam, oxygen and pulverized coal
- Aluminum reduction cells
- Rock wool furnaces
- Wire guides and blocks in pickling tanks
- Mannheim furnaces
- Hydrogen chloride burners
- Multiple hearth roasters, also rabble blades and teeth
- Artificial gas generators
- Spray nozzles
- Aluminum furnaces and pumps for molten aluminum
- Sinker rolls for aluminizing
- Acid slurry pumps
- Incinerators
- Slag bottomed boilers

### CHEMICAL RESISTANCE OF TYPICAL CARBORUNDUM REFRACTORIES

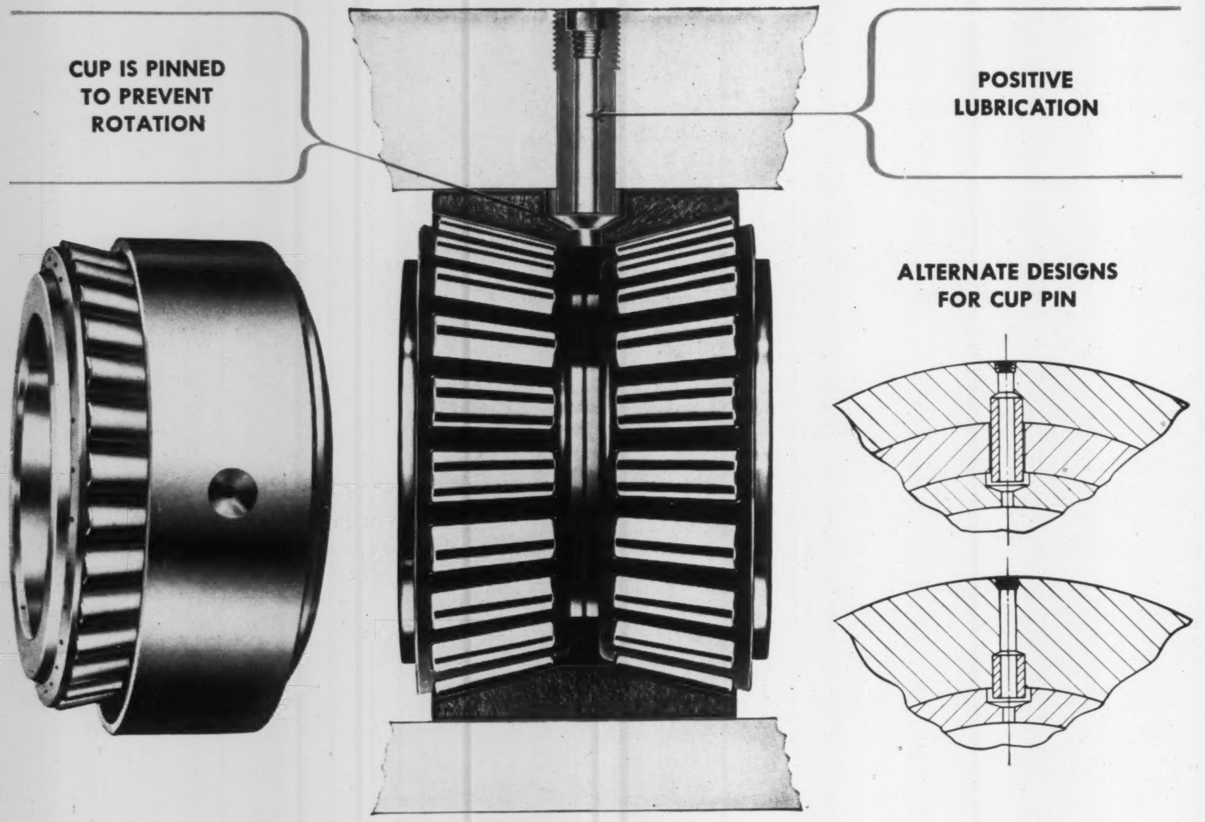
G = Good F = Fair NR = Not recommended

| | Silicon carbide | Aluminum oxide |
|---|---|---|
| **MOLTEN METALS** | | |
| AL | G | G |
| Sb | F | G |
| Cu | G | G |
| Fe | NR | G |
| Mg | F | G |
| Ni | NR | G |
| **ACIDS (Heated)** | | |
| $HHO_3$ | G | G |
| $H_2SO_4$ | G | G |
| **ACIDS (Heated)—Contd.** | | |
| $H_3PO_4$ | F | G |
| HCl | G | G |
| **GASES** | | |
| $CO_2$ | G | G |
| $H_2O$ | G | G |
| $O_2$ | G | G |
| $H_2$ | G | G |
| $Cl_2$ | NR | F |
| $SO_2$ | G | G |
| $S_2$ | F | G |

Super Refractories
by Carborundum

*Write today for your free copy of "Super Refractories by Carborundum." The address: Dept. ME-80, Refractories Division, Perth Amboy, N. J.*

*For engineered refractories, count on* **CARBORUNDUM®**


CUP IS PINNED TO PREVENT ROTATION
POSITIVE LUBRICATION
ALTERNATE DESIGNS FOR CUP PIN

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**REDUCES WEAR AND POUNDING**
**PROVIDES FOR POSITIVE LUBRICATION**

Now you can get a new Timken® bearing—first of its kind developed for floating bearing positions—that answers the problem of excessive wear from creeping and pounding in gear drives, spindles and many other applications. It's a pin-cup, double-row tapered roller bearing. Manufacturers can assemble and adjust gear drives, then merely set the pin. Result is a bearing that floats endwise but cannot turn in the housing. It greatly reduces wear, provides for continuous, positive lubrication. This new Timken bearing gives you all these advantages for those applications where there is an inherent tendency for the cup to creep or turn in the housing.

1) *Positive lubrication* because oil is fed continuously through the pin.
2) *Longer bearing life* because bearing creep is eliminated. Related parts are better protected, too.

This new pin-cup bearing results from Timken bearing research and development. Research to make machines perform better at lower cost. And the combined, new $2½ million engineering and research facilities of the Timken Company, unique in the industry, make progress like this possible. Make it yours when you use Timken bearings in the machines you build or buy. Another reason why "Timken" is your No. 1 bearing value.

**When you buy Timken bearings you get...**
1) *Quality you can take for granted.*
2) *Service you can't get anywhere else.*
3) *The best-known name in bearings.*
4) *The pace setter in lower bearing costs.* The Timken Roller Bearing Company, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits. *Canadian Division: Canadian Timken, St. Thomas, Ontario.*

**Industry rolls on**
**TIMKEN®**
**tapered roller bearings**